RAILROAD GAZETTE

QUARTO VOL. XXIV.—NO. 22. A JOURNAL OF TRANSPORTATION, ENGINEERING AND RAILROAD NEWS. THIRTY-SEVENTH YEAR.

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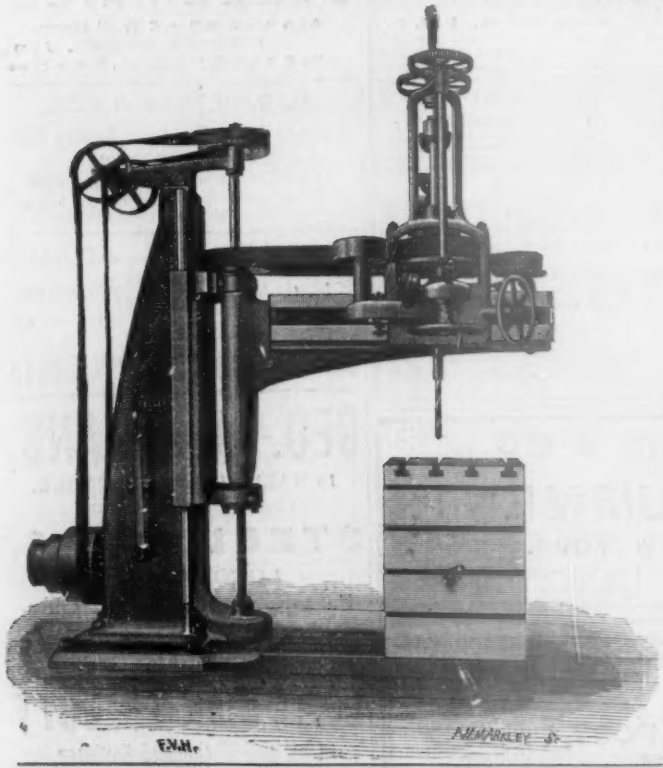

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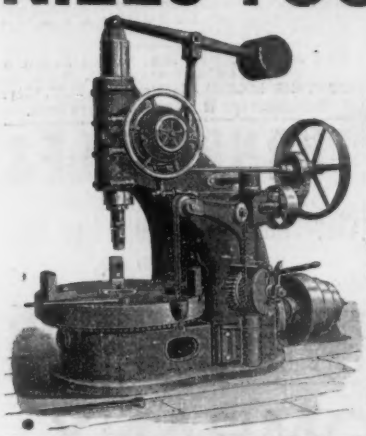

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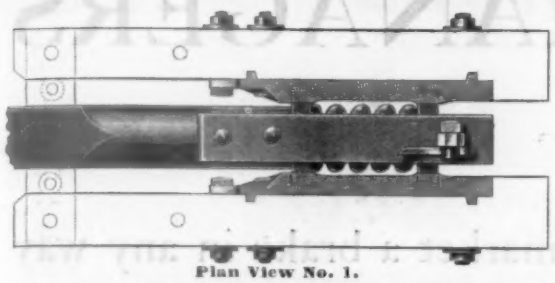

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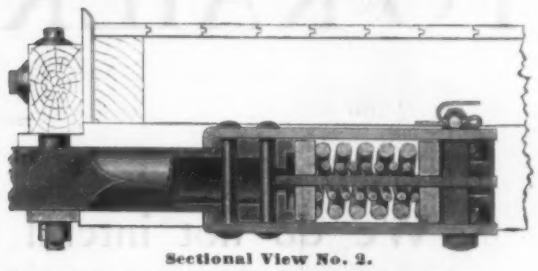

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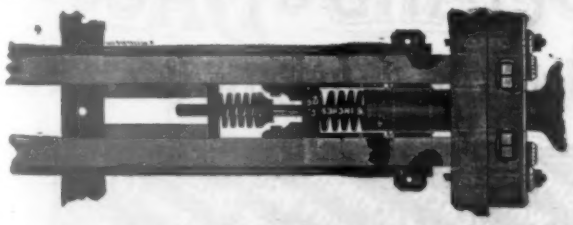

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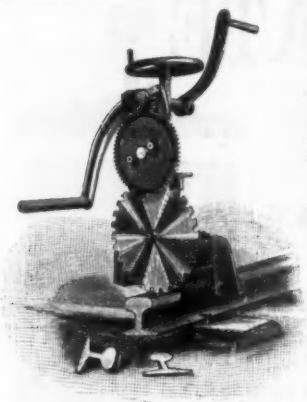

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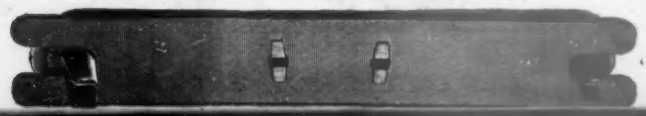

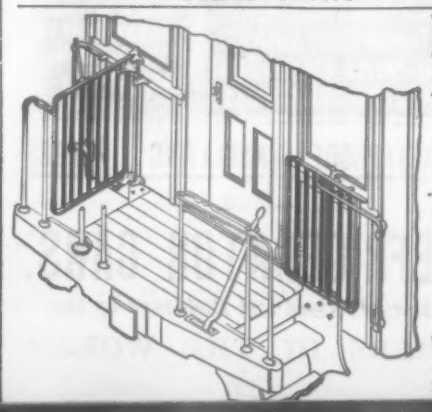

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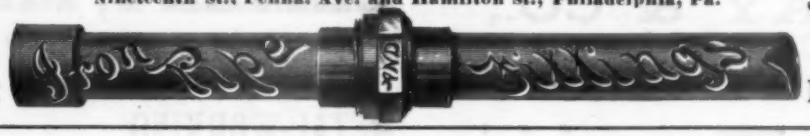

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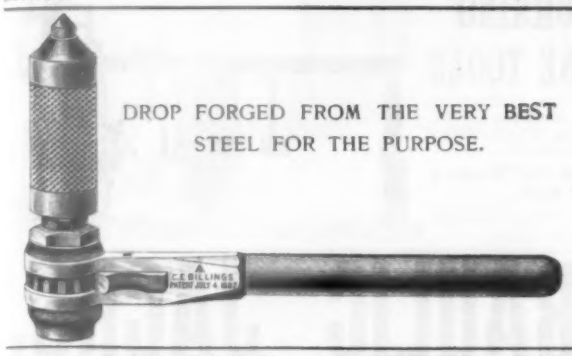

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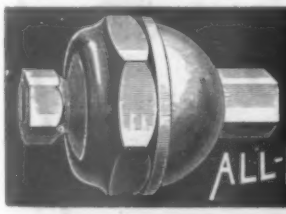

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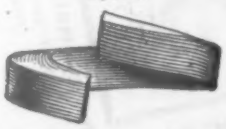

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A Resilient Spiral Spring Washer with Rachet-Shaped Teeth.

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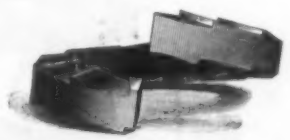

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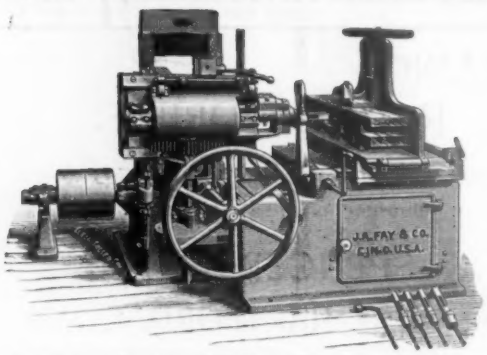

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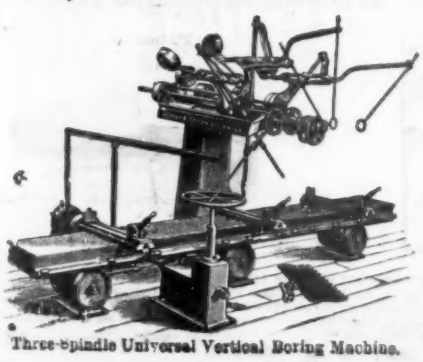

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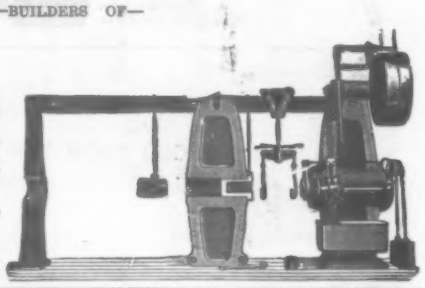
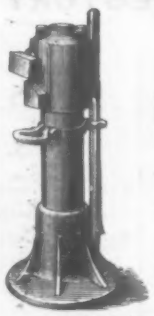


HYDRAULIC JACKS.



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All sizes. All styles. All warranted.

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Car Wheel Presses. Crank Pin Presses.

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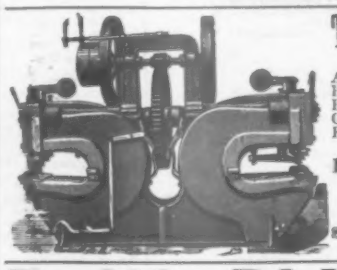

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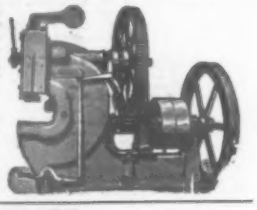

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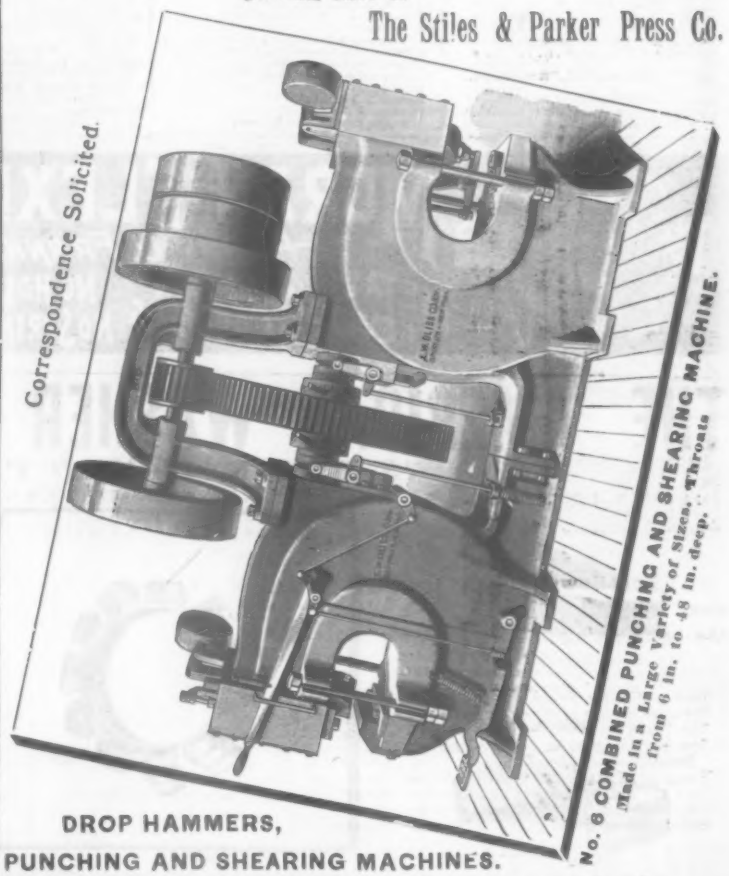

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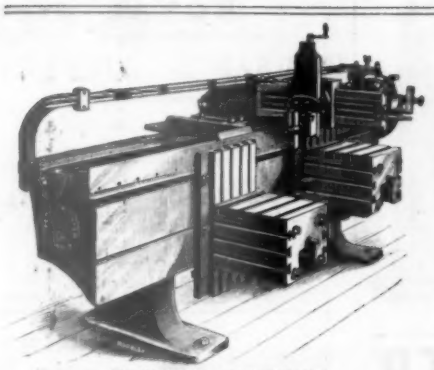

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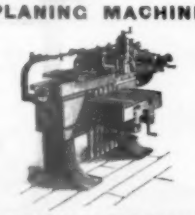

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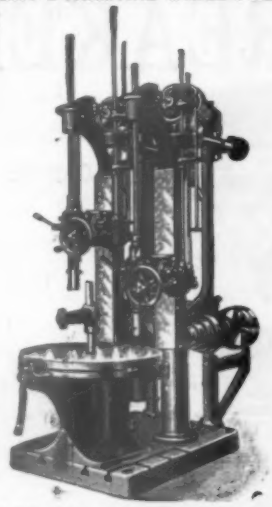

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Maker and Patentee of
Improved Hydraulic JACKS.

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Steam Hammers.
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Jacks for Pressing on Car Wheels or Crank Pins made to order.

TANGYE'S HYDRAULIC LIFTING JACK.

A good, reliable jack for lifting or pushing in any direction. The lever is for pumping it up, the key lowers and stops it at any point, when it is again ready for lifting, saving time and trouble

Various sizes made, from 4 tons to 200 tons.

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NEW ERA GRADER, DITCHER AND RAILROAD BUILDER.

Excavates canals at a cost of 2 cents per cubic yard, moving ***1,000 to 1,500 cubic yards in 10 hours with six teams and three men.*** Will make a canal 80 feet wide and 8 feet deep. Builds, removes and cuts down hills by loading 600 to 800 wagons of 1¼ yards each in 10 hours at 2½ cents each. Builds railroad embankments or country turnpikes for one-quarter the cost of any other appliance. We also make the Austin-Reversible Road Machine, Buck Scrapers, Wheel and Drag Scrapers, Contractors' Plows, and Street Sweepers. Send for catalogue.

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Large Special "PUNCHES" and "SHEARERS" for Bridge and Girder Work, Iron Buildings, etc., etc.

Foot Screw and Drop. Also Cutting, Punching, Forming, Shearing, Embossing, Coining and Drawing

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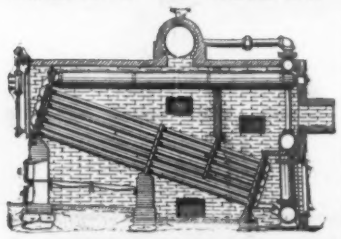

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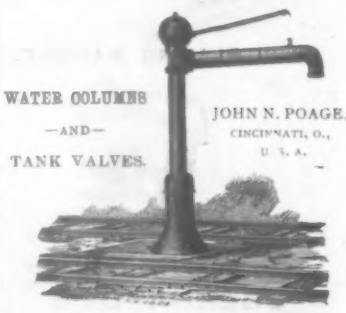

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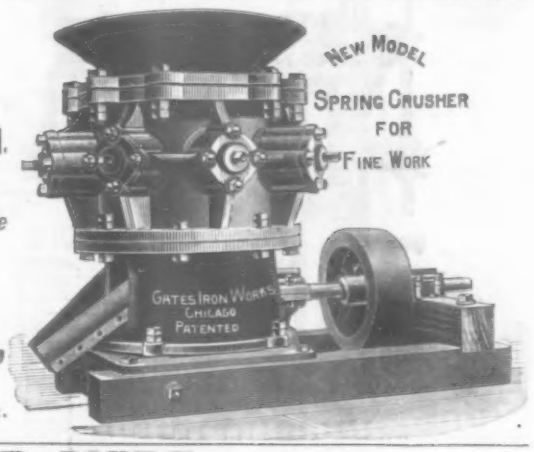

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THE FIELD FEED-WATER PURIFIER

This device will not successfully handle **all waters,** but there are **none** that it will not improve. In a **large majority** it will demonstrate great economy.

The apparatus can be made at railroad shops at small expense.

A trial is solicited at our expense.

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This water purifier is now in use and on trial on the following railroads:

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Office: 134 Van Buren Street. CHICAGO, ILL. **Factory: 43d St. & Stewart Ave.**

PLAN OF INCOME BOND CONVERSION.

Atchison, Topeka & Santa Fe Railroad Company.

OFFICE OF THE
ATCHISON, TOPEKA & SANTA FE RAILROAD CO.

P. O. BOX 346. No. 95 MILK STREET.

CIRCULAR No. 68. BOSTON, May 25, 1892.

TO THE INCOME BONDHOLDERS of the ATCHISON, TOPEKA & SANTA FE RAILROAD COMPANY:

On Oct. 15, 1889, Circular No. 63, containing Plan of Financial Reorganization of your Company, was issued.

This Plan, which was fully accepted in due course, related to all your properties, including Railways Owned 6,999.08 and Operated 7,178.91 miles, the details of which, as well as the necessities of complete rehabilitation of the same, are fully set forth in the circular.

The Operations of this railway mileage for the year ended June 30, 1889, were:—

Gross Earnings	$27,572,868.90
Net Earnings	6,772,390.71

while the absolute and obligatory Fixed Charges of the Company for the same year, including Interest on Bonds, Car Trusts, Sinking Funds, Taxes, Rentals, etc., were $11,200,000.00

showing an Annual Deficiency, without considering Improvements of any kind, of $4,427,609.29

This condition of affairs and the existence of a large Floating Debt created the necessity for urgent and radical treatment through scaling of the Fixed Charges to within the Operating possibilities of the Railways. To accomplish this, the General Mortgage Four Per Cent. Bond with Fixed interest and the Income Second Mortgage Five Per Cent. Bond with Contingent interest (if earned, after due regard for Improvements) were created. The CHARGES of your Company were thus reduced to

FIXED AND OBLIGATORY:

FOR INTEREST ON GENERAL MORTGAGE BONDS, TAXES, RENTALS, ETC. $8,000,000.00

CONTINGENT:

FOR INTEREST ON INCOME BONDS (IF EARNED AFTER IMPROVEMENTS, ETC.) $4,000,000.00

The Plan included the provision of a Cash Fund which was thought sufficient for the early improvement of the properties, which would as well enable some payment to be made on the Income Bonds from the beginning of operations under the Reorganization.

Improvements then found absolutely necessary, which had been postponed from lack of funds were prosecuted as vigorously and judiciously as possible, and efforts in that direction were largely reflected through the RESULTS, which are, exclusive of Net Earnings from sources other than railroad operations:

IN THE YEAR TO JUNE 30, 1890.

THE GROSS EARNINGS WERE	$31,004,357.03
GAIN OVER PREVIOUS YEAR (12 4-10%)	3,431,488.13
NET EARNINGS	10,083,970.77
GAIN OVER PREVIOUS YEAR (48 9-10%)	3,311,580.06

YEAR TO JUNE 30, 1891.

GROSS EARNINGS	$33,663,716.18
GAIN OVER 1889 (22 1-10%)	6,090,847.28
NET EARNINGS	9,620,546.54
GAIN OVER 1889 (42%)	2,848,155.83

YEAR TO JUNE 30, 1892.*

GROSS EARNINGS	$35,771,702.00
GAIN OVER 1889 (29 7-10%)	8,198,833.10
NET EARNINGS	10,886,218.00
GAIN OVER 1889 (60 7-10%)	4,113,827.29

(*Partly approximated.)

These increasing returns did not result from extraordinary crops, but reflected natural conditions from the steady growth of the country through which your mileage extends, and are such as to insure confidence of the Management in their continuance. The Company is the owner of large interests in Coal and other Properties and of Securities from which a large net revenue per annum is obtained, and which, added to Net returns from Railway Operations, make Aggregate of Net Earnings for each of the Fiscal Years above stated, as follows:

AGGREGATE NET EARNINGS FISCAL YEAR TO JUNE 30, 1890	$11,195,919.56
" " " " " " **JUNE 30, 1891**	10,390,702.76
" " " " " " **JUNE 30, 1892**	11,736,218.00

In the Income Bond created under the Plan of Reorganization, it is provided that it is optional with the Management that the cost of all Improvements made on the properties shall be deducted before interest is paid, and, as the fund provided under the Reorganization Plan became exhausted, these deductions had to be made, leaving a diminished rate of interest for the Income Bond coupons, viz.: 2¾ per cent. in the first period, 2 per cent. in the second, and 2½ per cent. now declared for the year just closing.

With the experience the Management has now obtained in operation of the properties, it is believed that the Improvements for several years to come should not be less than from $2,000,000 to $3,000,000 per annum, including Equipment recently acquired under Car Trust and such other Rolling Stock as may be deemed necessary for the future wants of the road.

With Improvements satisfactorily provided for, the Earning Power of the properties should be increased through reductions in Operating Expenses, secured by substantial and adequate additions to Plant.

The Improvements in question relate alone to Tracks, Road-bed, Buildings, Machinery and Rolling Stock *on existing mileage of the Atchison, Topeka & Santa Fe Railroad System as described in Circular* 63, which excludes the lines of the St. Louis & San Francisco and Colorado Midland Railway Companies, each of which has independent means for such purposes.

The Improvements made on the Railway lines from October, 1889 (period of Reorganization), to June 30, 1892, other than Rolling Stock not built at Company's Shops, and exclusive of Repairs and Renewals of Plant and Equipment charged into Operating Expenses (which more than offset depreciation), will amount to $4,900,000, additional to which there were purchased in years 1890 and 1891 Cars and Engines to the value of $2,508,945.48, which were placed under a Trust which will now be cancelled and this Rolling Stock enter directly under the Mortgage Liens, making an aggregate of NEW VALUES in Improvements and Equipment added to the property to June 30, 1892, of $7,408,945.48, to which will also be included from the operations of this Plan the additional sum of $2,500,000 in Cars and Engines now being delivered under Equipment Trust Series A.

It is the opinion of the Management that the time has now arrived when all of the obligations of the Company can be returned to a Fixed basis, sufficient funds provided to take care of all the Improvements of the road required for at least four years, and, if necessary, a longer period and at the same time the restoration of the junior Bonds and Capital Stock of the Company to a more permanent and stable market value, with assured returns on the first and probable balances for the latter.

With the foregoing facts presented, the Management offers the following to the INCOME BONDHOLDERS of the Company:

PROPOSED CONVERSION.

A Second Mortgage, under which the issue of Bonds will be as hereinafter stated, dated July 1, 1892, to expire July 1, 1989, covering all the properties of the Atchison and Auxiliary Companies named in Circular 63 of October 15, 1889, has been created, next in lien to the General Mortgage, under which Coupon Gold Bonds in denominations of one thousand dollars ($1,000) and five hundred dollars ($500) and Registered Bonds of five hundred dollars ($500), one thousand dollars ($1,000), ten thousand dollars ($10,000), and fifty thousand dollars ($50,000) each will issue, with FIXED INTEREST payable October and April in each year. Scrip in denominations of one hundred dollars ($100) will also issue bearing Interest payable when converted into Bonds.

The Bonds under this Indenture will all have the same security, and will be issued in two classes, viz.:

CLASS "A": $80,000,000.

TO DRAW FIXED INTEREST, PAYABLE OCTOBER AND APRIL.

3 MONTHS, ENDING SEPTEMBER 30, 1892	AT RATE OF, PER ANNUM	2½%
1ST YEAR, ENDING SEPTEMBER 30, 1893	" " "	2½%
2D YEAR, ENDING SEPTEMBER 30, 1894	" " "	3%
3D YEAR, ENDING SEPTEMBER 30, 1895	" " "	3½%
4TH YEAR, ENDING SEPTEMBER 30, 1896, AND THEREAFTER UNTIL MATURITY	" " "	4%

These Bonds will be delivered to holders of present Income Bonds, par for par, without expense to them, and at the same time and place such exchange is made a certificate for the sum of 2¼ per cent. interest declared payable on Income Bonds by the Management, from operations of the year to June 30, 1892, will be delivered, payable September 1, 1892. The INCOME BONDS deposited for exchange should have therewith COUPON NO. 3 OF SEPTEMBER 1, 1892, and all subsequent Coupons. The CLASS A SECOND MORTGAGE GOLD BONDS to be delivered in exchange for Income Bonds will have attached a Coupon for three months' interest due and payable October 1, 1892, at rate of 3½% per annum, and subsequent Coupons for Interest payable Semi-annually on April 1 and October 1 in each year as provided. The present Income Bonds so received will be deposited with the Union Trust Company of New York, Trustee of the New Second Mortgage, as part of the security of the Second Mortgage Gold Bonds, thus giving to these bonds, in addition to the Second Mortgage, the entire lien now given by the General Mortgage to secure the principal of the Income Bonds.

* * * * * * * * * * * * * * * * *

CLASS "B," $20,000,000.

TO DRAW FIXED INTEREST PAYABLE OCTOBER AND APRIL, AT 4% PER ANNUM.

These bonds to be issued in no greater sum in any one year than five million of dollars ($5,000,000), and only by the Trustee upon certificate of the Board of Directors of the Company duly furnished that the proceeds shall apply to specific Improvements (including Equipment) therein named on the mileage of the Atchison, Topeka & Santa Fé Railroad System as it existed as of July 1, 1892, exclusive of the mileage of the St. Louis & San Francisco Railway System and the Colorado Midland Railway. In the event that the Improvements in any one year shall not be equal to the proceeds of the $5,000,000 of Bonds, it is understood that the surplus proceeds of such bonds shall apply in the next year following to Improvements for such year, but to no greater amount than the proceeds of $5,000,000 of bonds in any one year, so that, while provision is made that bonds can issue in any one year to the limit of $5,000,000, the proceeds of the same may apply to more than the four years covered by the $20,000,000 of bonds; and it is also understood that the proceeds of none of these bonds shall apply to the extension of the company's lines beyond the mileage referred to.

* * * * * * * * * * * * * * * * *

The foregoing issues, of which the use of the Class B Second Mortgage Gold Bonds $20,000,000 extends over a period of *not less* than four years from July 1, 1892, will amount in the aggregate to $100,000,000 when all the Class B Bonds are issued, and at the end of four and one quarter years from July 1, 1892, become bonds of one class only, at the same rate of interest per annum, viz., 4%. Under this new Mortgage the right is reserved to the Company to issue Second Mortgage 4% Gold Bonds only after the full amount of the $20,000,000 Class B Bonds shall have been issued, to an amount not in any one year exceeding $2,500,000, for the same specific purposes, on the same mileage and under the same conditions as provided for the issue of the Class B Bonds, to a total limit of $50,000,000.

SEE NEXT PAGE.

Under this Plan, the fixed charges of the Company for four years, beginning with July 1, 1892, with no Contingent charges, excepting such as will pertain to dividends on Capital Stock, will be as follows:

FIXED CHARGES FIRST YEAR, BEGINNING JULY 1, 1892.

Taxes, Rentals, Interest on General Mortgage 4 per cent. Gold Bonds, etc		$8,000,000
2½ per cent. on $80,000,000 Class "A" Second Mortgage Gold Bonds		2,000,000
4 per cent. on $5,000,000 Class "B" Second Mortgage Gold Bonds		200,000
Total Obligatory Fixed Charges ahead of Capital Stock, First Year		$10,200,000

FIXED CHARGES SECOND YEAR, BEGINNING JULY 1, 1893.

Taxes, Rentals, Interest on General Mortgage Gold Bonds, etc		$8,000,000
2½ % Interest on Class "A" $80,000,000 Second Mortgage Gold Bonds, 3 mos	$500,000	
3 % Interest on Class "A" $80,000,000 Second Mortgage Gold Bonds, 9 mos	1,800,000	
		2,300,000
4 % on $10,000,000 Class "B" Second Mortgage Gold Bonds		400,000
Total		$10,700,000

TOTAL FIXED CHARGES THIRD YEAR, BEGINNING JULY 1, 1894.

Taxes, Rentals, Interest on General Mortgage Gold Bonds, etc		$8,000,000
3 % Interest on Class "A" $80,000,000 Second Mortgage Gold Bonds, 3 mos	$600,000	
3½ % Interest on Class "A" $80,000,000 Second Mortgage Gold Bonds, 9 mos	2,100,000	2,700,000
4 % Interest on $15,000,000 Class "B" Second Mortgage Gold Bonds		600,000
Total		$11,300,000

TOTAL FIXED CHARGES FOURTH YEAR, BEGINNING JULY 1, 1895.

Taxes, Rentals, Interest on General Mortgage Gold Bonds, etc		$8,000,000
3½ % Interest on Class "A" $80,000,000 Second Mortgage Gold Bonds, 3 mos	$700,000	
4 % Interest on Class "A" $80,000,000 Second Mortgage Gold Bonds, 9 mos	2,400,000	
		3,100,000
4 % Interest on Class "B" $20,000,000 Second Mortgage Gold Bonds		800,000
Total		$11,900,000

THE FIXED CHARGES FOR THE FIFTH YEAR, AND THEREAFTER, PROVIDED NO FURTHER ISSUE OF SECOND MORTGAGE BONDS SHOULD BE FOUND NECESSARY, WILL BE

Taxes, Rentals, Interest on General Mortgage 4% Gold Bonds	$8,000,000
4% Interest on $100,000,000 Second Mortgage Gold Bonds	4,000,000
Total	$12,000,000

In case the Improvements in any of the years above noted call for less than the proceeds of $5,000,000 Second Mortgage Gold Bonds, the Fixed Charges will be proportionately lower.

This includes Car Trust, Series "A," Atchison Company, in total amount $2,500,000. The first Car Trust of 1890-91 proposed to have been issued, in amount of $2,508,945.48, has been cancelled; and the Rolling Stock turned in under the lien of the General Mortgage and Second Mortgage Bond Indentures.

DEPOSIT OF BONDS FOR EXCHANGE.

INCOME BONDS WILL BE RECEIVED FOR EXCHANGE UNDER THIS PLAN, BEGINNING WITH JUNE 1, 1892, BY THE FOLLOWING APPOINTED AGENCIES:

UNION TRUST COMPANY OF NEW YORK, At Office of Atchison Company, 95 Milk St., Boston.

UNION TRUST COMPANY OF NEW YORK, 80 Broadway, New York City.

BARING BROTHERS & COMPANY, LIMITED, 8 Bishopsgate-within, London, E. C.

Holders forwarding bonds from distant points in America should ship them, by express, to the Union Trust Company of New York, 80 Broadway, New York City.

Holders in foreign countries should ship their bonds to Baring Brothers & Company, Limited, London.

All expenses of transmission of bonds delivered at either of the above Agencies will be paid by the Atchison Company.

Pending preparation of engraved bonds, the work upon which is proceeding with dispatch, Negotiable Certificates of the Company and Depository will be delivered Income Bondholders, to be exchanged without unnecessary delay for the former in due course. Application to list these certificates will be promptly made to the several Stock Exchanges in Boston, New York and abroad.

Income Bond Scrip of any class will be received for exchange, the same as the bonds, in amounts not less than $100, and in even hundreds or thousands.

Holders of any of the bonds called for exchange under Circular 63 of October 15, 1889, upon presenting their bonds to any of the Agencies mentioned, can effect the original and present exchanges at the same time.

To Enable the Company and Its Agencies to Promptly Carry Out the Exchange Offered Herein, Holders Should Deposit Their Income Bonds Before July 15, 1892.

SUBSCRIPTION TO SECOND MORTGAGE 4% GOLD BONDS CLASS "B."

The Management considers at present a fair basis of market value of the new Second Mortgage 4% Gold Bonds Class "B" to be 70.

Holders of Income Bonds depositing their Bonds for exchange are invited to subscribe to any amount of $5,000,000 of these bonds, which will be authorized to be issued for improvements to be made for the first year, beginning with July 1, 1892, at a price of 67, the bonds allotted to carry all coupons for Interest at 4% from July 1, 1892.

Each depositor of $1,600 in Income Bonds will be entitled to subscribe for $100 of the new Second Mortgage Class "B" Four Per Cent. Bonds. In the event of applications exceeding the total amount to be offered for subscription, the excess will be adjusted in proportion to holdings.

Arrangements have been made by which this subscription has been underwritten, a syndicate having been formed to take all the bonds not availed of by Income Bondholders:

SUBSCRIPTIONS WILL BE PAYABLE AS FOLLOWS:

10% IN CASH TO ACCOMPANY APPLICATION.
25% UPON ALLOTMENT.
25% WITHIN 30 DAYS AFTER ALLOTMENT.
20% WITHIN 60 DAYS AFTER ALLOTMENT.
20% WITHIN 90 DAYS AFTER ALLOTMENT.

Payments May Be Anticipated Upon Any Day Upon Which Instalments Are Due, and Interest Will Be Allowed Thereon at the Rate of Four per Centum per Annum.

The SUBSCRIPTION LIST will close on the 1ST OF JULY, 1892.

ALL CASH PAYMENTS under this Subscription will be made to the ATCHISON, TOPEKA & SANTA FE RAILROAD COMPANY, 95 MILK STREET, BOSTON, and at its Fiscal Agencies, Messrs. BARING, MAGOUN & COMPANY, 15 WALL STREET, NEW YORK, and Messrs. BARING BROTHERS & COMPANY, LIMITED, BISHOPSGATE-WITHIN, LONDON, ENG., at all of which places blanks will be furnished as may be required. Receipts will be issued by such depositories as Agents for the Subscribers upon the understanding that the moneys received shall be held in trust, not to be paid for the uses of the Railroad Company until the Directors of said Company shall officially announce that the Plan of Conversion has become effective.

ORAL AND WRITTEN INQUIRIES concerning this Plan and applications for Circulars and blanks for use thereunder can be made of Messrs. BARING, MAGOUN & COMPANY, 15 WALL STREET, NEW YORK CITY, Messrs. BARING BROTHERS & COMPANY, LIMITED, LONDON, ENG., and of J. W. REINHART, VICE-PRESIDENT, ATCHISON COMPANY, 95 MILK STREET, BOSTON. By order of the Board of Directors.

J. W. REINHART, *Vice-President.* **GEORGE C. MAGOUN,** *Chairman.*

SCALES FOR TURNOUTS.

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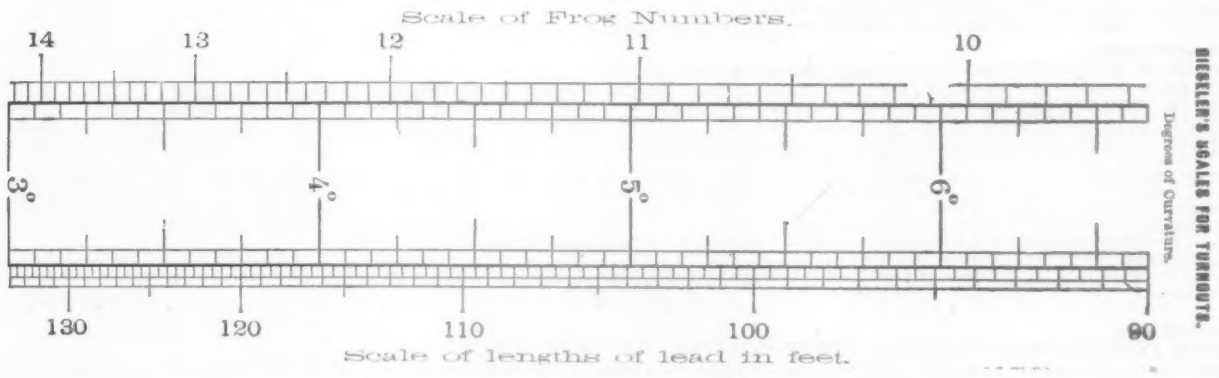

Giving graphically the frog numbers, length of lead and degree of curvature for turnouts from 3° up to 42° 30'. Printed on stiff cardboard and folded to pocket size (3 in × 8 in.). Much more convenient and certain than tables. Price, with full directions for use, 25 cents, or ten for $2.00

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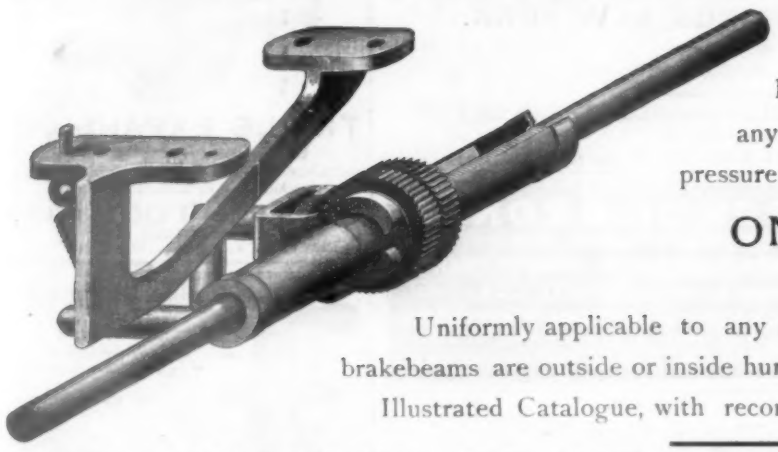

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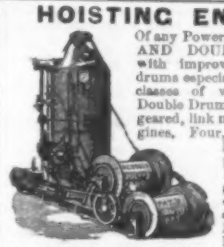

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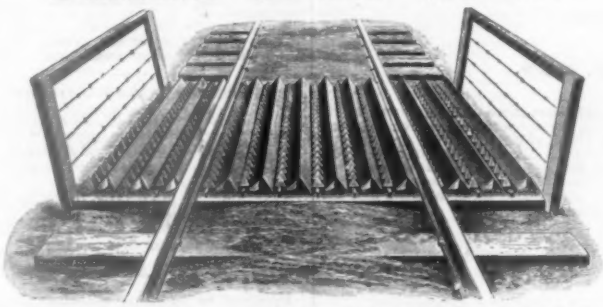

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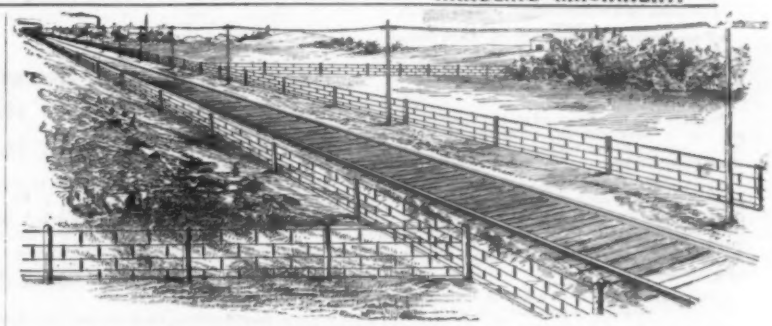

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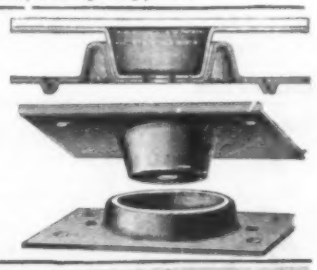

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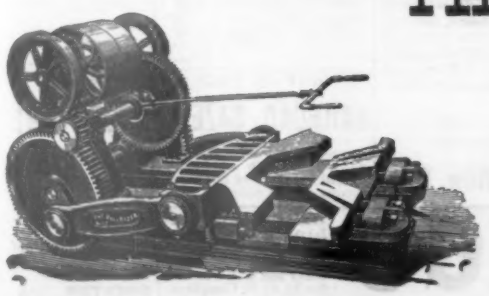

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THE SANITARY DISTRICT OF CHICAGO.

TO CONTRACTORS.

Sealed proposals addressed to the Board of Trustees of the Sanitary District of Chicago and indorsed:

PROPOSALS FOR EXCAVATING THE MAIN DRAINAGE CHANNEL will be received by the clerk of the said Sanitary District at Room H Rialto Building, Chicago, Ill., until 12 m. (standard time) of Wednesday, the 8th day of June, 1892, and will be publicly opened by the said Board of Trustees at the regular meeting held that day, or at a special meeting called for that purpose.

The work for which the said tenders are invited is the excavation of the main drainage channel for the said Sanitary District between Willow Springs and Joliet, Ill., and consists in all of about 11,500,000 cubic yards of rock, of about 5,000,000 cubic yards of earth, the building of 287,241 cubic yards of dry rubble walls, and 244,444 square yards of slope paving.

Bids will be received on three different propositions, designated as "Proposition 1," "Proposition 2," and "Proposition 3," respectively.

As provided under the different propositions said work will be divided into 14 to 17 sections, each of which will be treated as a separate contract in canvassing the proposals and making awards, except as otherwise provided in Proposition 3. As all awards will be made by individual sections or a group of sections, as provided in the specifications and forms of proposals to be furnished bidders, each bidder must make prices for each section, or a group of sections, as the case may be, separate and distinct from every other. The lumping of prices in any bid other than as given in the form of proposal under Proposition 3 will render such bid informal and will cause its rejection by the said Board of Trustees.

As the question of which proposition will be acted upon will not be determined by the Board of Trustees until after the time set for receiving proposals the bidder is allowed to make three alternative tenders based upon the terms of the specification for each of the three propositions respectively.

Each proposal must be accompanied by a certified check or cash to an amount equal to $3,000 multiplied by the number of sections bid upon, whether said sections stand singly or in a group. Provided, that the said check or cash shall entitle the bidder to make tender under any or all three of the said propositions.

All certified checks must be drawn on some responsible bank doing business in the city of Chicago and be made payable to the order of the Clerk of the Sanitary District of Chicago. Said amount of $3,000 for each section will be held by the Sanitary District until all of said proposals have been canvassed and contracts awarded and signed, the return of said check or cash being conditioned upon any bidder to whom an award of any portion of said work may be made appearing within 10 days after notice of such award being given, with bondsmen, and executing a contract with the Sanitary District for the section or sections of said work so awarded, and giving a bond satisfactory to the said Board of Trustees for the fulfillment of the same in the amount of $100,000 oreach section of work awarded him, whether said sections be awarded singly or in a group.

All proposals must be made on blank forms furnished by the Sanitary District and must give the price for each separate item of work. A form will be furnished for each of the three propositions.

The bids will be compared on the basis of the engineer's approximate estimate of quantities, which will be furnished with copies of the specifications.

No proposal will be considered unless the party making it shall furnish evidence satisfactory to the Board of Trustees of his ability to do the work, and that he has the necessary pecuniary resources to fulfill the conditions of the contract, provided such contract shall be awarded him.

Bidders are required to state in their proposals their individual names and places of residence in full.

Specifications may be had and plans may be seen at the office of the Chief Engineer, Room E Rialto Building, Chicago, Ill.

The said Board of Trustees reserve the right to reject any and all bids.

THE SANITARY DISTRICT OF CHICAGO,
By FRANK WENTER,
President of Its Board of Trustees.

Attest:
THOMAS F. JUDGE, Clerk.
Chicago, Ill., April 7, 1892.

Notice to Contractors.

Complete plans, profiles and specifications of The Sanitary District of Chicago, Ill., Main Drainage Channel can be seen at the office of the INGERSOLL-SERGEANT DRILL CO., 10 Park Place, New York.

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They are the result of long years of study and experience in construction work on different railroads. It has been the aim of the author to put nothing in the specifications which needs to be erased, leaving blank lines in proper places for insertion of such conditions as are needed for special localities. They are believed to properly guard both the company's and the contractor's interests, and to be adapted for use on all railroads in America.

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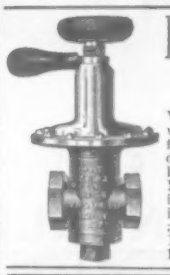

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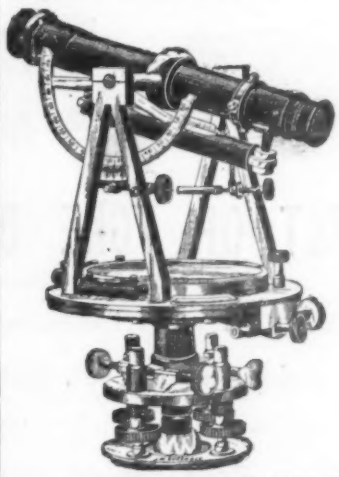

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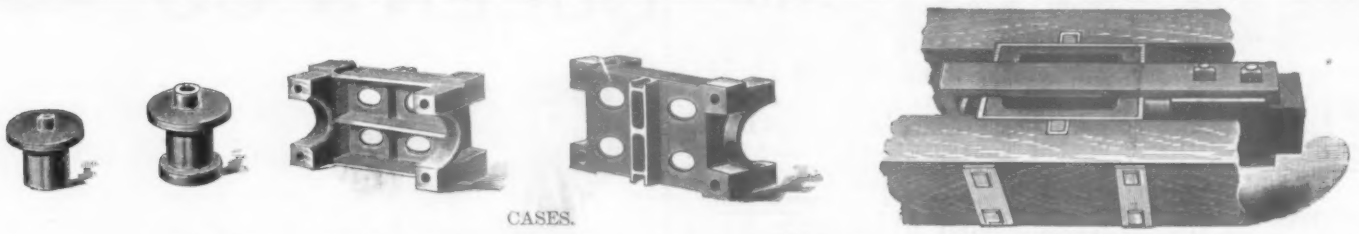

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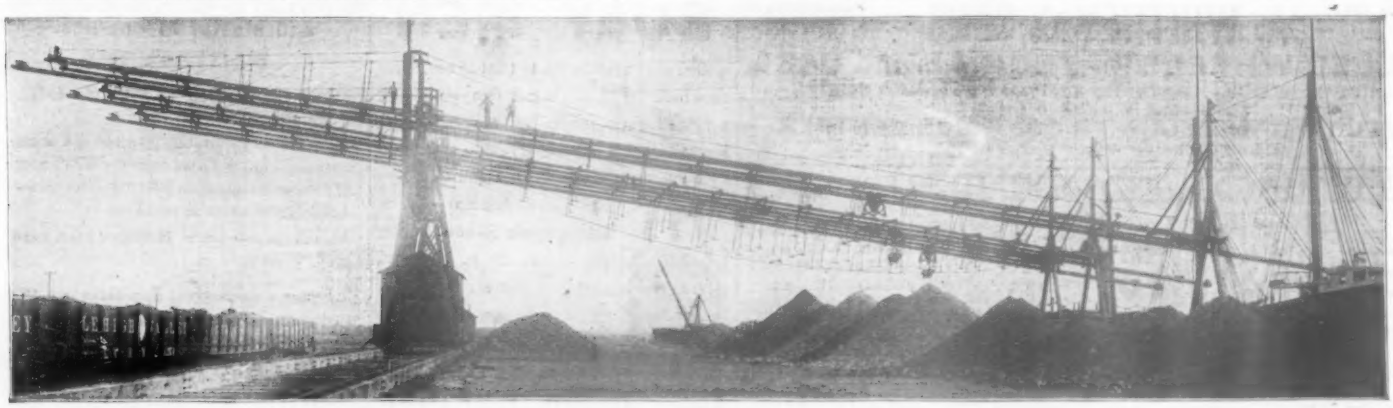

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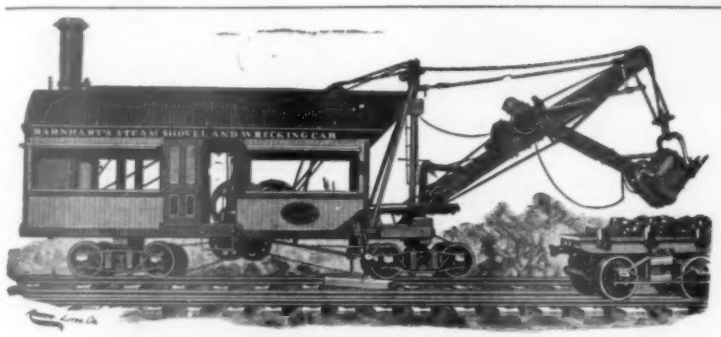

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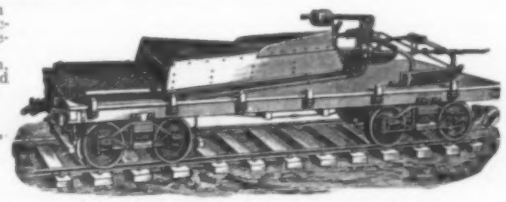

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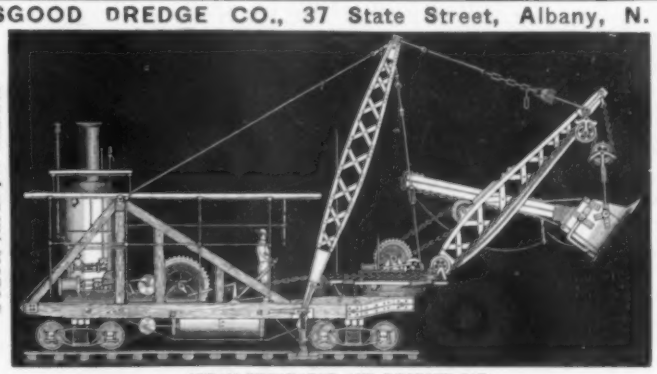

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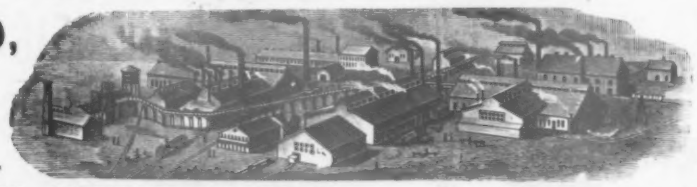
SPRINGFIELD,  ILLINOIS.

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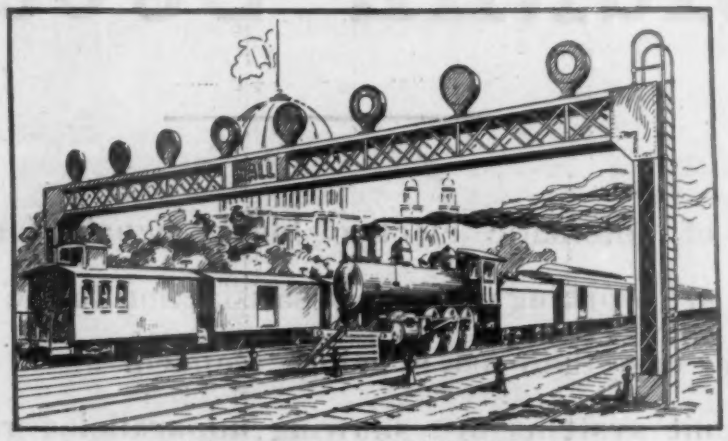

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RAILROAD GAZETTE

FRIDAY, MAY 27.

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Contributions.

Night Signals.

CHICAGO, May 21, 1892.

TO THE EDITOR OF THE RAILROAD GAZETTE:

The recent revival of the discussion on the best plan for lighting semaphores has not, it seems to me, brought out any new points, and the purpose of this note is only to ask of "R. C. E.," your last week's correspondent, a question or two, which, if he will be good enough to answer, will make his position much clearer, and perhaps add weight to what he has already said.

Why is Mr. Carter's system of lighting affected by the failure of the C. & N. W. Ry.'s telegraph department to adopt it? Should not the blame rather be cast upon those who, seeing its advantages, fail to adopt it? I certainly will be glad to know, and I believe the country at large, also, whether Mr. Salmon in his patent screen method has devised any way for covering in the day time a semaphore arm which stands in the danger position. Up to the present I cannot see why it is not just as bad to disregard a horizontal arm as to disregard a red light.

I cannot refrain from alluding to the wise, witty, and need I add poetical composition by Mr. Hammond contained in your issue of May 13, which reminds me forcibly of that eloquent appeal made by Sergeant Buzfuz in behalf of that lonely and heart broken female Mrs. Bardell. It cannot fail to draw the tear of pity from the heart of the too susceptible railroad superintendent. Personally I have no "blade" with which to meet Mr. Hammond in the forensic arena, but I feel impelled to caution him that there are other blades prowling around only waiting for a chance to get at him.

Let him beware that *his* blade does not turn out to be nothing but a boomerang with a tendency to recoil on him.

LUKE FORWARD.

Easement Curves.

Massachusetts Institute of Technology,
BOSTON, April 22, 1892.

TO THE EDITOR OF THE RAILROAD GAZETTE:

Easement or transition curves have had a fair degree of attention paid them during the last few years, and there are many methods of running them in. The results reached are mostly satisfactory, whatever method is used. Convenience in the method of running in such curves, then, becomes the main point to be considered. Many prefer to use deflection angles, as with Searles' spirals; some prefer to use offsets. The method shown below may interest some of the latter. The method of work is not original with the writer, but the discussion is. The field work and the calculations seem reasonably simple.

Spiral Easement Curves.—Upon tangent, track ought to be level across; upon a circular curve the outer rail of the curve should be elevated in accordance with the formula $e = \frac{g v^2}{32.2 R}$. In passing directly from tangent to circular curve there is a point (at P. C.) where two requirements conflict; the track cannot be level across and at the same time have the outer rail elevated. It has been the custom to elevate the outer rail for 100 or more feet back from the P. C. on the tangent. This is not satisfactory. It is, therefore, becoming somewhat common to introduce a curve of varying radius, in order to pass gradually from the tangent to the circular curve. The transition will be most satisfactorily accomplished when the elevation e increases uniformly with the distance l from the P. E. (point of easement), where the spiral easement curve leaves the tangent; so that $\frac{e}{l}$ is a constant, or $\frac{g v^2}{32.2 R l} = A$ (a constant), or $R l = \frac{g v^2}{32.2 A}$; but $g - v - A$ are constants; we may therefore put the equation in the form $R l = C$ (1)

To further investigate the qualities of this curve let α = angle of inclination of curve to tangent at any point, then

$$R d\alpha = d l$$
$$d\alpha = \frac{d l}{R} = \frac{l d l}{C}$$
$$\alpha = \frac{l^2}{2 C} \quad (2.)$$

Again $d x = d l \sin \alpha$ and $d y = d l \cos \alpha$. Since all values of α within the limits of the spiral easement curve must be small, we may with slight error assume for simplicity that—

$\sin \alpha = x$ and $\cos \alpha = 1$.

then $d x = \alpha d l$ and $d y = d l$ (approx.)

whence $y = l$

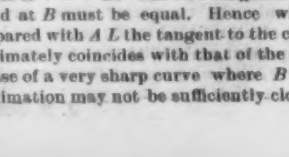
from (1.) $R y = C$ (3.)

from (2.) $\alpha = \frac{y^2}{2 C}$ (4.)

$$d x = \alpha d l = \alpha d y = \frac{y^2}{2 C} d y$$

whence integrating $x = \frac{y^3}{6 C}$ (approx.) (5.)

The equation shows the curve to be approximately a "cubic parabola."



A useful and simple application of the cubic parabola is shown below.

FIELD-WORK.

(*a.*) Lay off tangent $E D$.

(*b.*) Offset from any point C on tangent and run in circular curve $A B$ (offset by any distance $A C$ desired).

(*c.*) Find the distance $A L$ such that $B L = 3 A C$.

(*d.*) Make $E C = A L$.

(*e.*) Mark K so that $A K = K C$.

(*f.*) Fix any desirable point W by the formula

$$x = x_b \left(\frac{y}{y_b}\right)^3$$

(*g.*) Fix any desirable point T by the formula

$$S T = x_b \left(\frac{y_b - y}{y_b}\right)^3$$

It will in general be sufficiently accurate to take $A B = A L$ and $S B = V L$.

It remains to be proved that with the field-work indicated above:

I. The curve passing through the points E, W, K, B, as described, is in fact a cubic parabola.

II. The curves, circular and parabolic, have a common tangent at B.

III. The curves, circular and parabolic, have the same radius at B.

IV. The offset $S T$ is correctly calculated.

I. In the figure, let $A B$ be the circular curve
$E D$ the tangent
$E K B$ the cubic parabola
$A L$ a tangent to $A B$ at A
$B F$ a tangent to $E K B$ at B
$B D = 4 A C$
$E C = C D$
$A C = L D$

Then from the equation of the cubic parabola

$$B D = 8 K C$$
$$4 A C = 8 K C$$
$$A C = 2 K C \quad (6.)$$
$$B D = 4 A C$$
$$B L = 3 A C \quad (7.)$$

The position of W follows directly from the equation of the cubic parabola.

II. The tangent to the cubic parabola at any point is found thus:

$$\tan \alpha = \frac{d x}{d y} = \frac{\frac{y^2}{2 C} d y}{d y} = \frac{y^2}{2 C}$$

For the point B $\tan \alpha_b = \frac{y_b^2}{2C}$

but $\tan \alpha_b = \frac{B D}{F D} = \frac{x_b}{FD}$, or

$$F D = \frac{x_b}{\tan \alpha_b} = \frac{6 C}{\frac{y_b^3}{y_b^2}} = \frac{y_b}{3} = \frac{2}{3} C D$$

By similar triangles $V L = \frac{1}{3} F D = \frac{1}{2} C D$. Therefore for the cubic parabola $A V = V L$ and approximately the tangents $A V = V B$. The two tangents to the circle at A and at B must be equal. Hence where $B L$ is small compared with $A L$ the tangent to the cubic parabola approximately coincides with that of the circle.

In the case of a very sharp curve where $B L$ is large, the approximation may not be sufficiently close.

III. From (3) and (5) the radius of easement curve

$$R_e = \frac{C}{y_b} = \frac{\frac{y_b^3}{6 x_b}}{y_b} = \frac{y_b^2}{6 x_b}$$

the radius of circle $R_c = \frac{(\text{chord } A B)^2}{2 B L} = \frac{A L^2}{2 B L}$ (approx.)

$$= \left(\frac{y_b}{2}\right)^2 \div 2 \times \tfrac{3}{4} x_b$$
$$= \frac{y_b^2}{6 x_b} \text{ (approx.)}$$

and the radii of easement curve and of circle are approximately equal.

IV. In the figure, required the offset ST.

$$US = AC + VS$$
$$= \frac{x_b}{4} + BL \left(\frac{AT}{AL}\right)^2 \text{ (approx.)}$$
$$= \tfrac{1}{4} x_b + \tfrac{3}{4} x_b \left[\frac{y - \frac{y_b}{2}}{\frac{y_b}{2}}\right]^2$$
$$= \tfrac{1}{4} x_b + \tfrac{3}{4} x_b \left(\frac{4 y^2}{y_b^2} - \frac{4 y}{y_b} + 1\right)$$
$$= x_b + x_b \left(\frac{3 y^2}{y_b^2} - \frac{3 y}{y_b}\right)$$
$$UT = x_b \frac{y^2}{y_b^2}$$
$$ST = US - UT = x_b \left(1 - \frac{3 y}{y_b} + \frac{3 y^2}{y_b^2} - \frac{y^3}{y_b^3}\right)$$
$$= x_b \left(1 - \frac{y}{y_b}\right)^3$$
$$= x_b \left(\frac{y_b - y}{y_b}\right)^3 = x_b \frac{VL^3}{ED^3}$$

By making $VL = EZ$ it follows that $ST = WZ$. S can, however, in most cases be set by offset from ED as a point on the cubic parabola, more conveniently than from the curve AB.

C. FRANK ALLEN.

The Floods in the West and South.

CHICAGO, May 24, 1892.

Since our report of last week it has become quite evident that the damage done to railroads has been much worse than was thought at that time. Reports are received daily of damage done to roadbeds and some few bridges. The report that the Omaha bridge was seriously injured was not true. The embankment at the east end was cut away, but trains were moving over the bridge after a delay of eight hours.

The worst disaster was at Sioux City, Ia., on the 18th, when the Floyd River was greatly swollen by a "cloud burst." The river rose so rapidly as to cut off retreat of families living on the low lands and about 20 persons were drowned. Among the railroads the loss is estimated at $200,000 and over. The Chicago, St. Paul, Minneapolis & Omaha bad washouts along the Floyd River for a distance of over 30 miles, but it resumed traffic within 48 hours. Its roundhouse at Sioux City was badly damaged by the water, but the company estimates its total loss there at only $2,500. The Sioux City & Northern probably suffered worse than the Omaha, but few details are procurable. At Sioux City and in the Floyd Valley it lost much track, many culverts and some bridges. The Chicago, Milwaukee & St. Paul roundhouse at Sioux City was damaged. The stockyards were submerged. All bridges across the Floyd went down except one. The total loss at Sioux City is estimated at $1,500,000, the packing houses being, perhaps, the worst sufferers aside from losses on dwellings and city property.

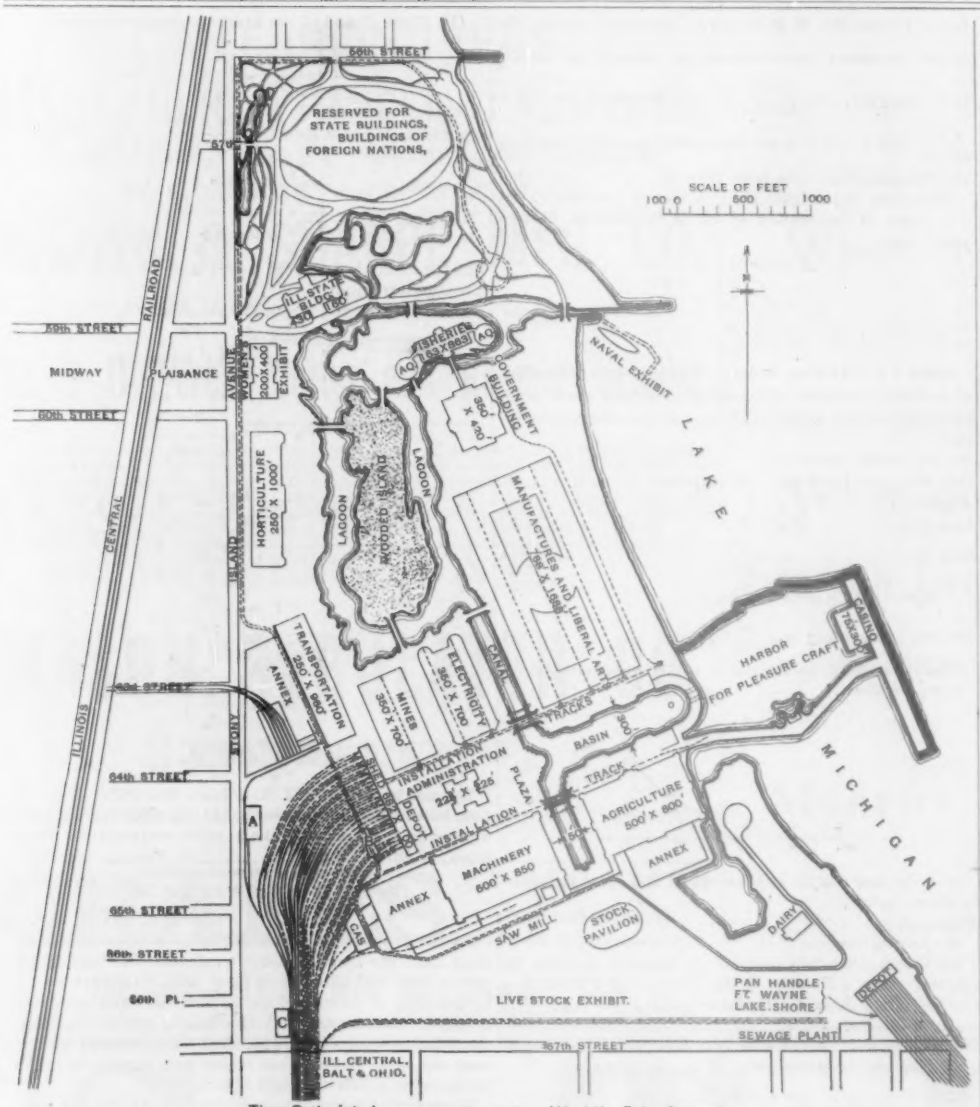
On the Sioux City & Pacific a bridge over the Little Sioux River was carried out on Monday, the 23d.

At Kansas City the Missouri Pacific tracks were under water, but regular trains resumed running on the 23d. The river broke through the temporary embankments thrown up to protect the breweries and elevators on the East Bottoms and caused much damage to property. The towns of Harlem, Armourdale and Argentine were still submerged at last accounts.

The Missouri Pacific had a washout at Union, Neb., cutting off the connection with Nebraska City. Trains were run via Weeping Water and Auburn. The new line to Plattsmouth will not be opened at present on account of softness of tracks.

Much damage was suffered by the railroads at Leavenworth. At Alton, Ill., the damage is mostly to farms and bottom lands. Some 10 miles of new grading has been washed out opposite the city belonging to the Chicago, Burlington & Quincy and the Missouri, Kansas & Texas roads, and intended to be used as an approach to the new Missouri River bridge. The Egyptian levee broke and inundated the town of Alexandria, Mo. The high winds caused the waves to break through the banks. This levee was worked upon until the last moment by large gangs of men, but their efforts proved useless.

The Governor of Illinois has visited the flooded districts in that state, and has supplied the homeless with tents, blankets, cots and other quartermaster stores. The American Bottom, extending from Alton to Cairo, 200 miles long by seven miles wide, is under from seven to ten feet of water, as is also the bottom land on the opposite side of the river, in Missouri. Estimates of the probable loss are placed at $11,000,000, for the district immediately surrounding St. Louis.



The Railroad Arrangements at the World's Fair Grounds.

The various railroads in the flooded districts have repaired their embankments with bags of sand, rubble and rip rap. At Alton, where a serious change in the river current threatened the Chicago & Alton's embankment, train loads of rock were dumped into the water. Most roads took warning and were prepared to run relief trains to points of danger at short notice.

Much high water in Arkansas has resulted in ruining a great deal of railroad property. At Ottumwa, Ia., local rains caused a heavy rise in the already overflowed Des Moines River. All tracks entering the city were under water, some as much as 4 ft. At Burlington, Ia., the Burlington, Cedar Rapids & Northern, had to abandon all trains and the Chicago, Burlington & Quincy had to send through trains via Quincy and Carthage Junction.

The Chicago & Northwestern, the Chicago, Milwaukee & St. Paul and the Illinois Central suffered seriously in Iowa and Southern Minnesota. The latter road ran trains into Sioux Falls on the 19th after a long interruption. The storms did much damage as far north as Northern Minnesota, and the Northern Pacific and the Great Northern were interrupted by washouts.

The broken levee at Gypsy Plantation submerged the Louisville, New Orleans & Texas road for over a mile, and the company has had to build inclines so as to transfer trains around this break on boats.

The St. Louis, Iron Mountain & Southern was blocked north of Texarkana by the rise of the Red River.

The depredations of river pirates have been serious in many places. They sack houses when the inmates leave them to seek safety, and the owners on returning find everything of value gone.

One noticeable feature of the floods has been the great value of railroad embankments as levees. In many cases they have been relied upon to protect where the ordinary levees have been washed away and broken down. The superiority of the railroad banks is doubtless due to the care with which they have been fortified and strengthened after the floods of previous years.

Most of the railroads in the territory above referred to have two serious problems and all of them one. The first is to make a detailed estimate of the cost of repairs to roadbeds, which is as yet hardly possible, and to prepare for the large expenditures. The second is to estimate the effect on business for a year to come due to the losses suffered by the farmers. The crops may be so seriously damaged as to materially affect the aggregate grain production of the whole country; but the statements up to date are mostly conjectures.

ST. LOUIS, May 21, 1891.

The present flood in the Mississippi River at this place has attained a height of 36 ft. above low water, where it has stood for four days, and is likely to stand for a week longer. This is higher than any flood here since 1844, when the stage was 41 ft. 9 in. above low water, or 5 ft. 9 in. higher than this flood. All the low ground on both sides of the river is covered. Front street, or what is commonly called the Levee, on the St. Louis side, being some 3 ft. under water. On the Illinois side all the levees have been overflowed, as well as most of the railroad embankments.

The city of East St. Louis is almost entirely surrounded by water. Temporary levees, or earth banks covered on the top and outer slope with gunny sacks filled with earth or sand, are the only barriers now opposed to the flood. These extend entirely around the city, and reach now to a height of from one to two feet above the present water stage. They are built on the tops of the railroad embankments and tracks which surround and intersect the town in every direction. I personally inspected these defenses yesterday and find that they are likely to prevent any further damage to railroad interests and to property in East St. Louis.

There are now but three lines open eastward from East St. Louis, these being the Ohio & Mississippi, the Louisville & Nashville and the Cairo Short Line. All the other roads from the east centring here come in over these three lines. Passenger traffic seems to be free from all obstruction, except some delay in trains on some roads caused by traversing circuitous routes. The Belt road is under water. All the lines running to Alton are abandoned between East St. Louis and Alton, a distance of 20 miles.

The handling of freight in East St. Louis is entirely stopped. Those roads which have their freight terminals on the west side of the river are uninjured, except for the circuitous routes necessitated to reach one of the three lines named. Some freight and passengers are being transferred to Alton by boat.

The O. & M. embankment will serve as a sure barrier against the flood on the north side of East St. Louis if the temporary levee above described, along the line of the Vandalia (Pennsylvania) road should fail. This temporary dyke is 3 ft. high on top of the Vandalia track, for miles, with the water standing 2 ft. above the level of the track, or within a foot of the top of the dyke. The stage of water is one foot above the level of the yards at the east end of the Eads Bridge, and only the temporary dykes prevent the abandonment of all railroad traffic across the bridge.

There is no present probability that the situation will grow any worse, and no prospect for any material improvement for a week or ten days yet.

J. B. JOHNSON.

General Superintendent J. Q. Van Winkle, of the Terminal Railroad Association, of St. Louis, writes us as follows:

In your issue of May 20, under the head of "Floods in the West and South," you state that " . . . traffic across the Eads Bridge had to be suspended because the tracks of several or all of the the roads centring at East St. Louis were under water. The Burlington, the Alton and some other roads ran their passenger trains over the Merchants' Bridge." Your information must have been obtained from a wrong source, inasmuch as traffic "across the Eads Bridge" was never stopped for an instant. The only interference with traffic took place at the junction of our tracks with those of the lines reaching us from the north, while our connection with lines from the east and the south (with the exception of one of the latter whose tracks became submerged) was never interrupted. All the north lines arranged to run their trains over the tracks of the Ohio & Mississippi and Vandalia roads, to which two roads we delivered, and from them received, the entire east and north traffic, passenger as well as freight. So far from suspending traffic, the Eads Bridge, during the entire period of the flood, pulled every passenger train that crossed the river into or out of the Union Depot, and all of its engines and crews were in service day and night to handle the heavy freight business which came to it because of the failure of the other transfer agencies at this point.

Two fatal collisions of trains resulted indirectly from the floods. Near Greenville, Ill., on the 21st, at 6 a. m., a Jacksonville Southeastern locomotive on the Vandalia road, running there on account of the impassability of the Jacksonville track, ran into a Vandalia passenger train, killing an express messenger. Cause, running without proper orders. At Goldman, Ark., on the St. Louis Southwestern, on the night of the 20th, a passenger train stopped by the floods was run backward some distance, and, by a mistake about meeting points, ran into a freight, killing nine and injuring 21 persons, most of them passengers. A sleeping car was overturned and fell off a trestle into a bayou.

Intramural Railroad and Terminals in Jackson Park, Chicago.

The systems of "intramural" railroads and terminals for the World's Fair Grounds at Jackson Park have been practically settled upon. The cut gives in general the route of the "intramural" elevated line, which has been recently changed considerably at the south end of the park. It parallels the south line of Machinery Hall, then skirts the lagoon near the live stock exhibit, turns east and runs north past the leather exhibit building, completing the south loop around the Indian school. This change lengthens the line somewhat, making it 2½ miles between loop terminals.

The "Alley" elevated railroad will enter the park at Sixty-third street, and will have a five track terminal above the transportation annex, as shown. The structure will be similar to that used for the park extension.

The terminals for the Illinois Central, the Baltimore & Ohio and those roads that will use the tracks of these lines will be massed in 12 sets of three tracks each (the centre track being an engine track) branching from 24 parallel tracks entering from the south. These 24 tracks branch from four main line tracks on the Illinois Central and the Baltimore & Ohio.

The Western Dummy Company, which will build and operate the Intramural Elevated, has submitted its plans to the Committee on Grounds and Buildings, and in general they are accepted. The elevated structure will be a combination of steel and wood trestle, built principally of 12 in. × 12 in. timbers and 15 in. I-beams. The foundations will be either concrete or cribwork. The caps will be of 12 × 12 timber, and their length will be nearly the full width of the completed structure, that is, about 24 ft. The posts will be 25 ft. between centres wherever possible. Longer spans will be made when needed, as when passing entrances of buildings or crossing roadways. On top of the caps will rest four 15-in. steel I-beams spaced to be directly under the rails. Upon these I-beams are placed the ties, rails and guard rails, as is usual in elevated railroad practice. The details of the iron work have not yet been worked out.

The cars will have two trucks, but it is not definitely decided what arrangement of electric motors will be adopted. Single motor cars, with motors on both trucks, and electric locomotives and motors on all trucks of all cars are being discussed. The current will be transmitted through the rails. The proposed locomotive weighs 20 tons, has two pairs of drivers, coupled, with direct acting motors.

The Illinois Central will make the proper connections to these tracks to accommodate the northbound and southbound trains. The Baltimore & Ohio will also accommodate itself to this arrangement. The depot for the Illinois Central and Baltimore & Ohio terminals will be a structure 150 × 300 ft., two stories high, and a receiving shed 682 × 100 ft. The Pittsburgh, Fort Wayne & Chicago, the Pittsburgh, Cincinnati, Chicago & St. Louis, and the Lake Shore & Michigan Southern, will have their terminals at the southeast corner of the park, consisting of six systems of two tracks each, facing the Forestry exhibit, and east of the stock exhibit sheds. In order to reach the terminals these roads will make connections with, and use the South Chicago branch of the Illinois Central.

The depot will be a structure 75 × 350 ft. facing the Forestry exhibit. This arrangement will relieve the crush that would naturally result from the concentration of all trains at one point.

The Intramural road will have stations to connect with the Alley elevated and all surface road terminals

At the Alley elevated and the Illinois Central and Baltimore & Ohio they will connect their stations by means of covered footways, entering at the second story. The details of the terminal stations, tracks, etc., will not be completed for several weeks. The specifications for the main terminal tracks and switches at the southwest entrance are: "All tracks to have at least 900 ft. clearance between switches, tracks generally 13 ft. centres, 30 ft. at platforms, using 12° 30′ curves and No. 7 frogs, split switches, 9° slips, all to be interlocked."

Since the map shown herewith was made it is learned that the Pennsylvania and the Lake Shore & Michigan Southern were unable to make satisfactory terms for the lease of land known as the Willard tract adjoining the park where their entrance was to have been. They are renewing the negotiations with the Illinois Central, which will possibly result in an agreement whereby the former roads will use the tracks of the Illinois Central from Grand Crossing to Seventy-first street and into the fair by the exposition tracks from Sixty-seventh to Seventy-first street. This would bring the terminus of the two roads within ground devoted to railroad uses by the fair in the southwestern quarter of the site.

Boiler for Johnstone Double Bogie Compound Locomotive.

The Rhode Island Locomotive Works have contracted to build some double-bogie compound locomotives for the Mexican Central from designs prepared by Mr. F. W. Johnstone, Superintendent of Motive Power of that road, and patented by him. The designs, except the boiler, were given in the *Railroad Gazette*, March 25, 1892.

The engine has two independent boilers with independent draft appliances rigidly connected in one frame and carried on two sets of driving wheels, six in each set, mounted on a swiveling frame, one set being placed at each end of the engine. There are also two guiding trucks of the radial type, one under each end. The cylinders are connected rigidly to the boiler frames; the connecting rods, therefore, are arranged with swiveled joints to enable the driving wheels to assume a proper position on the curves without cramping the bearings. The boilers are of the Belpaire type, as shown in Figs. 1 and 2. The shells are 52 in. in diameter, with the grates 56 × 56 ins. There are 201 two-inch tubes 15 ft. and 9 ins. long. The stays which hold up the crown sheet are made with thimbles and through bolts, as shown. Above the outside firebox the stays are secured by a copper washer and screw cap nuts.

The fire doors are on the side of the boiler, as the boilers are placed back to back with insufficient room for the fireman; hence, the firing is done from one side of the engine for both boilers. The back heads are stayed with heavy T-irons with pin connected braces running through the first sheet of the shell. The longitudinal seams of the shell are but jointed with lap welds, as shown in fig. 3. Underneath the shell at the centre is a plate $\frac{7}{16}$ thick at the point where the centre bearing for the swiveling frame is attached.

The engines for which these boilers were designed are compounded on the Johnstone plan, which, as we have before described, has the high pressure cylinder inside the low pressure, the low pressure piston being annular. The designs of these engines are the most novel that have been brought out for some years, and the results of service on the heavy grades on the Mexican Central cannot fail to be interesting.

New York Rapid Transit Commission.

At the meeting of the Supreme Court Rapid Transit Commission May 17, Chief Engineer William E. Worthen was cross-examined by Mr. O. B. Potter.

The witness said that the plans prepared by him contemplated a station at every quarter of a mile along Broadway; the station platforms to be underneath the sidewalks and to extend along the whole front of one block and connect with the streets on either side of it. This would require, therefore, the excavation of the entire width of the street up to the houses on each side for about 320 ft. in each mile of the road. His opinion was that of the owners of property fronting on the platforms of the stations, about 90 per cent. would be glad to have their basements opened to the platforms, or protected only by glazed windows. The question of damage or benefit to the adjacent property was not included in his estimates of the cost of the road. The fronts of the buildings on Broadway are chiefly supported on piers at the building line and extending down at least as far as the subcellar. He considered it possible to underpin those columns without shoring up the entire front of the building. He had done a great deal of such work himself; among other buildings the old Society Building on Broadway had been so treated twice.

The cross examination by Mr. Potter was very tedious as to local details of the width of Broadway at various points, and the minor details of the construction of the road as proposed by the witness.

The counsel was confident that the methods employed by the old practical builders in New York for doing such work were better than any which could be devised by anybody else, and he tried very hard, but without the slightest success, to get the witness to say that he thought the old rule-of-thumb methods of work were better and safer than those which the witness practiced himself.

The witness considered it perfectly feasible to hold up the superincumbent sand by tunneling under Broadway by means of iron poling plates from three-eighths to one-half of an inch thick, resting on supports with a cutting edge in front, the chamfer being on top, so that the sand penetrated would be forced upward and compressed to a greater extent than in its original condition. When the poling plates were to be shoved forward, he would inject in holes drilled in the iron roofing plates which had been inserted a preparation of coal tar, which would protect the iron and become incorporated with the sand which would then come in contact with the roofing plates. He stated that such treatment of iron with coal tar would, in his opinion, protect the iron thoroughly, as it had done to his knowledge for 45 years. At Houston street it would be necessary to carry the tunnel under the sheave pits of the cable railroad, which are 24 ft. below the street. It would be necessary there to carry the bottom of the tunnel to 41 ft. below the surface, or just above the tide level, and he considered that the ground water would be found at about that level.

In response to a question by Mr. Potter, Mr. Worthen confirmed the statement made in his direct examination that if Broadway had to be opened from the surface for the whole or greater portion of the way between the Battery and Thirty-third street, the construction of the road would be injudicious and impracticable.

Those who know Mr. Worthen can readily understand the pleasant yet forcible manner in which he stated to his persistent cross-examiner that he had made mistakes in the course of his professional career, and that he had profited by them, and that he knew more than most of the so-called practical men and was better able to conduct difficult work than they.

At this point in the proceedings Mr. S. Riker filed an appearance before the Commission as representing the Sailors' Snug Harbor property on Broadway from Astor Place to Tenth street, and Mr. S. P. Nash filed an appearance on behalf of the Corporation of Trinity Church, so that it appears as if some of the owners of important property affected by the proposed road had at length come to the conclusion that the Rapid Transit Commissioners' plans were not altogether acceptable.

The next witness was Richard Deeves, a builder, who apparently volunteered his testimony, presented in the form of a rather diffuse typewritten document which he read to the Commission. With reference to the proposed mode of constructing the tunnel and of underpinning the front of buildings, as proposed by Mr. Worthen, the witness was of opinion that such a method might be pursued with success with interior isolated columns in a building, but not where piers supported the front walls. With reference to the difficulties of safe construction in the fine sand, the witness gave some instances of the failures of sheet piling in the fine sand near Mercer street, where owing to the negligence of the foreman of the laboring gang trenches had caved in and damage to the adjoining buildings had ensued. He thought that from Wall street to Thirty-third street on Broadway only about one-half of the buildings had deep cellars, and he considered that the foundations of Trinity and Grace churches would be imperilled by deep and wide excavations on Broadway in front of them.

Mr. Bowers next took the witness in hand, and put on record the facts that he had never constructed a tunnel, nor was he an engineer, and that his paper, on which he had been occupied from about 8 o'clock to 2 o'clock on the previous night, had been prepared without consultation with any engineer. The further cross-examination was devoted to bringing out the rather crude and undigested notions of the witness as to what he would propose in place of the plans of the Rapid Transit Commissioners.

The Commission then adjourned to Thursday, May 20, at 2 p. m., at which time Robert L. Darragh took the stand and was examined by Mr. Potter. Mr. Darragh is a master builder of many years' experience in New York City, and was Croton Aqueduct Commissioner for some years prior to the passage of the charter of 1870.

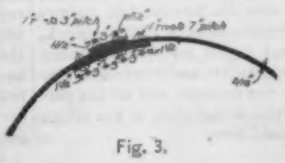


Fig. 3.

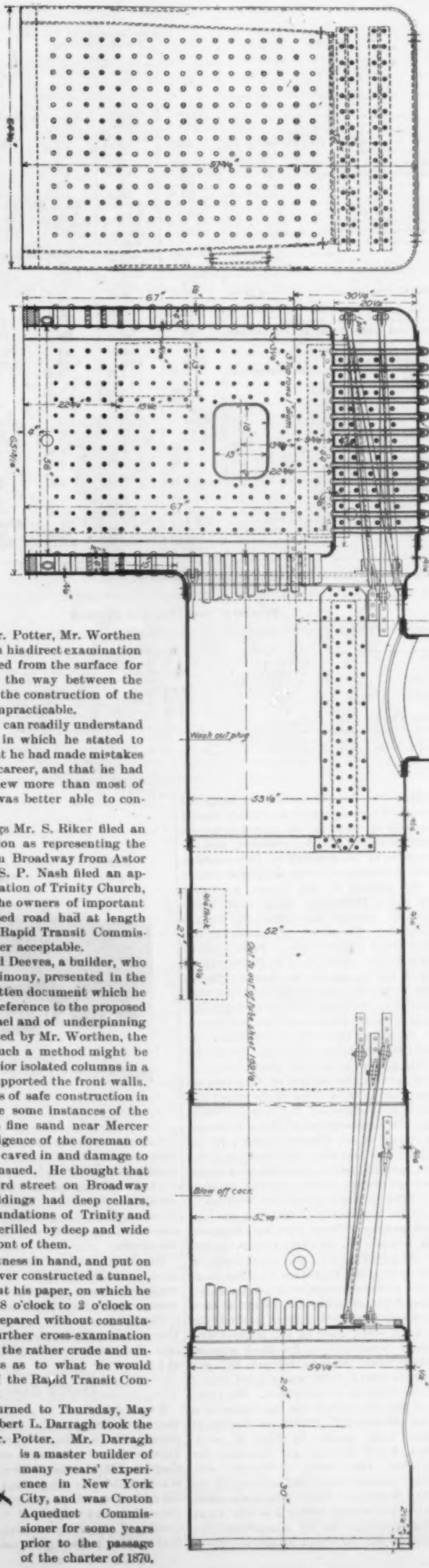


Fig. 1.

Fig. 2.

OLD COLONY RAILROAD.—RESULTS OF TESTS OF SIMPLE LOCOMOTIVES 169 AND 235 AND COMPOUND LOCOMOTIVE 232 ON THE NEW YORK EXPRESS FREIGHT BETWEEN BOSTON AND FALL RIVER.—TESTS MADE ON ROUND TRIPS, 98 MILES, OCT., NOV., DEC., 1891.

		Simple Locomotive No. 169. Pocahontas Coal.				Simple (O. C. Standard) Locomotive No. 225. Pocahontas Coal.				Compound Locomotive No. 232. Trip 1, with Pocahontas Coal. Trips 2, 3 and 4 with Cumberland Coal.			
		1.	2.	3.	4.	1.	2.	3.	4.	1.	2.	3.	4.
1	Weather	Rainy.	Cloudy.	Clear.	Snowing.	Clear.	Clear.	Clear.	Clear.	Cloudy.	Clear.	Clear.	Clear.
2	Condition of rail	Wet.	Good.	Good.	Wet.	Good.	Good.	Good.	Good.	Slippery.	Good.	Good.	Good.
3	Size of exhaust nozzle, single or double		Single, 4¼ in. diameter.				Single, 4½ in. diameter.				Single, 4¼ in. diameter.		
4	Weight of train in tons of 2,000 lbs., excluding the locomative and tender	376.0	338.04	357.2	376.0	366.6	404.2	385.4	394.98	385.4	357.2	404.2	413.6
5	Average number of cars on round trip	20.0	18 0	19.0	20.0	19.5	21.5	20.5	21.0	20.5	19.0	21.5	22.0
6	Maximum boiler pressure by gauge	152	154	153	149	174	172	174	172	190	185	185	185
7	Minimum " " " "	134	130	134	126	149	140	136	140	160	160	160	155
8	Average " " " "	143.2	143.1	144.6	139.5	160.6	159.0	159.4	156.2	176.4	175.5	173.7	171.3
9	Prevailing points of cut-off	6.5 in.	6.5 in.	6.5 in.	6.5 in.	7 in. & 10 in.	7 in. & 10 in.	7 in. & 10 in.	7 in. & 10 in.	12 in.	12 in.	12 in.	12 in.
10	Time made up in minutes	None.	None.	None.	4 m. 26 s.	5 m. 7 s.	None.	5 m. 35 s.	11 m. 43 s	None.	None.	1 m. 5 s.	1m. 45 s.
11	Aggregate intermediate stops	7 m. 16 s.	16 m. 20 s.	17m. 25 s.	12 m. 26 s.	13 m. 7 s.	43 m. 33 s.	19 m. 35 s	1:14:8	8 m. 50 s.	10 m. 15 s.	14 m. 5 s.	11 m. 55 s.
12	Time during which power was developed	2:57:2	2:50:55	2:58:1	2:57:38	2:31:35	2:55:19	2:42:29	2:43:57	2:43:9	2:42:39	2:45:5	2:45:30
13	Schedule time in motion		3:48:0				3:48:0				3:48	3:48	
14	Actual " " "	3:54:9	3:53:10	3:56:20	3:43:34	3:42:53	3:49:27	3:42:25	3:46:17	3:50:55	3:43:15	3:46:55	3:48:15
15	Average speed, miles per hour	25.1	25.2	24 7	26.4	26.5	25.7	26.5	27.2	25.5	25.8	26.0	26 0
16	Actual weight of coal used	8,119	7,034	7,439	7,869	6,798	7,046	5,681	6,333	4,2 3	4,35[illegible]	4,857	4,736
17	" " " wood used	500	540	500	400	350	350	400	400	400	400	400	400
18	Average weight of coal burned per sq. ft. of grate per hour	109.6	95.4	99.3	111.3	96.4	97.1	80.8	92.6	58.3	6[illegible].3	68.2	66.1
19	Number of miles run per ton (2,000 lbs.) of coal	24.2	27.9	26.4	24.7	28.9	27.8	31.5	31.0	46 2	45.1	40.2	41.1
20	" pounds of coal used per mile	82.8	71.8	75.9	80.3	69.3	71.9	58.0	64.6	43.4	44.4	49.9	48.3
21	Weight of ashes and unconsumed coal in ash pan and firebox	608	555	646	733	433	461	365	383	377	503	364	414
22	Weight of cinders or sparks in smokebox	667	556	564	665	393	440	244	196	200	254	220	198
23	" combustible utilized	7,044	6,123	6,429	6,691	6,112	6,285	5,242	5,934	3,836	3,754	4,173	4,254
24	Percentage of ashes and unconsumed coal in fire box and ash pan	7.31	7.67	8.45	9.13	6.24	6.41	6.08	5.60	8.54	11.15	7.2	8.46
25	Percentage of cinders in smokebox	8.02	7.55	7.39	7.53	5.66	6.12	4.17	3.02	4.53	5.63	4.35	4 04
26	" combustible consumed	84.70	84.60	84.20	83.30	88.10	87 47	89.75	91.38	86.90	83.20	88.40	87.50
27	Average temperature of feed water	64°	64°	65°	65°	60°	58°	59°	57°	53°	57°	55°	56°
28	Weight of water drawn from tender	52,000	46,750	51,875	51,950	43,375	46,625	41,750	42,875	37,625	36,750	39,125	38,500
29	Waste of injector	67	81	62	71	150	143	130	111	98	85	98	104
30	Weight of water evaporated	51,933	46,669	51,813	54,179	43,225	46,482	41,620	42,764	37,527	36,665	39,027	38,396
31	Actual evaporation per pound of coal	6.39	6 63	6.96	6.88	6.36	6.59	7.32	675	8.83	8.43	7.97	8.11
32	Equivalent evaporation from and at 212° per pound of coal	7.67	7.95	8.35	8.26	7.69	7.97	8.85	8.16	10.74	10.22	9.68	9.85
33	Equivalent evaporation from and at 212° per pound, combustible	8.84	9.14	9.67	9.71	8.55	8.94	9.60	8.72	11.93	11.[illegible]6	10 58	10.88
34	Coal used per car mile	4.14	3.98	3.39	4.01	3.56	3.66	2.82	3.06	2.11	2.33	2.32	2.19
35	Water " " " "	26.49	26.46	27.83	27.54	22.62	22.06	20.71	20.78	18.68	19.70	18.51	17.81
36	" " " hour while developing power	17,604	16,432	17,504	18.304	17,152.7	15,8[illegible]4.2	15,414.8	15,6[illegible]4.4	13,848	13,529	14,140	13,911
37	" " " " per sq. ft. of heating surface	13.95	13.02	13.87	14.50	11.84	10.95	10 64	10 82	10.22	9.99	10.44	10.27
38	" " " " " " " grate "	921.26	864 84	921.26	963.37	902.7	834.9	811.3	824.4	728.8	712.0	744.2	732.1

Coal used includes that used in banking overnight at Fall River.

PRINCIPAL DIMENSIONS OF ENGINES.

Engine	No. 169.	No. 235.	Compound No. 232.
Diameter of boiler	55 in.	52 in.	55 in.
Grate surface	19.2 sq. ft.	19.2 sq. ft.	19.2 sq. ft.
Number of 2-in. tubes	234	211	215
Heating surface	1,362 sq. ft.	1,372 sq. ft.	1,364 sq. ft.
Diameter of cylinders	18 in.	18 in.	20 in. and 28 in.
Stroke of pistons	24 "	24 "	24 in.
Diameter of driving wheels	68 "	69 "	69 "
Travel of valves	6¼ "	5 "	6¼ "
Lap of valves	1⅝ "	⅞ "	1 "
Inside clearance of valves	0 "	0 "	¼ "
Lead of valves		1/16 "	1/32 "

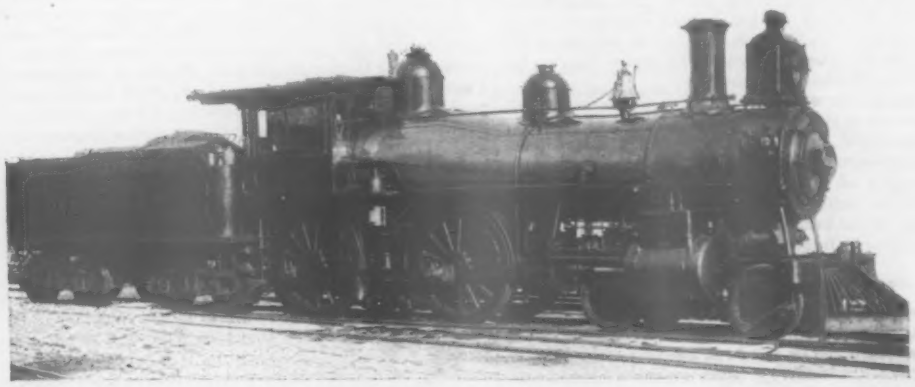
The witness stated that he considered the proposed method of construction impracticable as a whole chiefly on account of the lack of room in the tunnel to handle the great amount of material to be removed, and the variety of operations to be directed in this confined space, particularly in the case of there being rock from 5 to 8 ft. below the surface of the street, as would be the case all along Broadway from near Tenth street. It would be almost impossible to do the work without opening the street or shattering the various pipes and other substructures. From a familiarity with the sewers and water pipes on Broadway, of which he had had charge during his term of office as Croton Aqueduct Commissioner, he did not think that the profiles presented by the Rapid Transit Commissioners correctly represented the location of the rock nor its character under Broadway above Waverley Place. At any rate, it would be impossible to provide for the reconstruction of the sewerage on the entire length of Broadway without opening the surface of the street for the whole distance along both sides of the street and building new sewers and adjusting the house connections with them. On examination of the exhibits accompanying the report of the Commissioners, it appeared that nothing was said about the location of the Broadway sewers, nor the proposed methods of reconstructing the sewerage system before, during or after the construction of the proposed sub-surface railroad.

With reference to the possibility of building the tunnel in the proposed manner without opening the street except as regards sewers, Mr. Darragh thought it was possible to do almost anything with the expenditure of sufficient time and money, but he did not consider it at all feasible to do the proposed work without loosening the sand and having it run into the cut, except at such expenditure both of time and money as to preclude the possibility of the work being done by any persons who would hope to receive remuneration for their expense from the travel which would come to the road. In lower Broadway, the witness stated, there was a good deal of loose sand and some pockets of quicksand. He mentioned the case of the excavation for the cellar of a building near the Merchants' Hotel in Cortlandt street, which had been made by him a number of years ago when acting as foreman for the contractors for the work. Water was encountered, and they pumped water and sand out of the excavation until the Merchants' Hotel, which was some 40 ft. distant from the pit, moved bodily 2 or 3 in. away from the adjoining building. As for supporting the front piers of buildings on the street by shoring them from below without opening the surface, in the manner proposed by Mr. Worthen, the witness thought that sufficient bearing could not be obtained for the shoring without driving piles, which would necessitate the opening of the street. For all the older buildings along Broadway, he thought that it would be necessary to shore them up at the second story from the surface of the street.

Mr. Darragh did not know anything of the freezing process mentioned by Mr. Sooysmith. He said that he supposed almost anything could be done if time and money enough were expended on it. He thought that it would take about 10 years to get from the Battery to Union Square by the plan proposed by the Commissioners. The Commission adjourned until Monday, May 23, at 1 p. m.

The Old Colony Compound.

We are permitted to publish the particulars of some very careful comparative tests of the Old Colony Compound and two simple locomotives on the same road. This compound locomotive was built in the Old Colony shops, and Mr. Lauder, Superintendent of Rolling Stock, is responsible for the designs in all particulars except the cylinders, valves, starting valves and receivers. The dimensions and weights of the engines, and all the particulars of the tests are given so minutely in the tables that nothing more need be said here.



Compound Locomotive—Old Colony Railroad.

The B. & O. and the Staten Island Rapid Transit.

The plans for the improvements of the Staten Island terminals of the Baltimore & Ohio and the Staten Island Rapid Transit have been made public during the past week, and the developments in the terminal facilities already begun will take two or three years to complete and cost upward of $1,500,000. The terminal improvements will extend along the water front at St. George for nearly a mile, and will run back as far as Jay street, South street and Richmond Terrace.

The first step in these developments will be the construction of the new ferry slips and stations for the rapid transit roads, which follow the northern and southern shores from St. George as a centre. The present ferry slips are situated at the foot of Wall street, St. George. These will be torn down by the end of the present year and two new slips constructed some 1,200 ft. to the south, opening directly into a new station from which double tracks will run on one side to Tottenville and Arrochar and on the other to Erastina and the Baltimore & Ohio main tracks. The large triangular space between these tracks will ultimately be leveled down and become part of the new freight yard; for the present this space, as well as all the ground between Jay street and the water front, will be idle. A foot bridge for passengers will extend from the second story of the new station to Jay street, giving easy access to all trains. All teams and trucks using the ferry will pass in and out by way of Ferry avenue, thus avoiding the necessity of crossing the main tracks and interference with the foot passengers.

On the site of the present ferry slips there will be erected two covered freight piers, each about 500 ft. in length and parallel with the two piers already built there. These will be known as Piers 3 and 4, and will be used by the railroad company for storing and handling; between them will be a dock large enough to receive ocean steamships so that freight can be loaded and unloaded directly from the cars.

To accommodate the increased business the plans provide for the enlargement of the present freight yard on the present site, until it has a capacity of 1,500 cars, with about 25 tracks. This enlargement will be gradual and as necessity demands.

North of piers 1 and 2, which are already constructed, there will be two open piers for storage, one about 500 ft. long, and the other about 350 ft., for discharging rough freight directly from the car and loading on lighters. Between these there will be three transfer bridges for loading cars on floats. North of these open storage piers the plans provide for two coal piers, of which one is already constructed.

The present ferry and train service will be increased as the traffic demands, and local trains will be running over the Baltimore & Ohio tracks as far as Cranford, N. J., within the present year. The B. & O. will probably erect its new shops at or near Erastina.

At present 300 cars are being handled daily over the Arthur Kill bridge at St. George, and 12 car floats and 25 other vessels are in use. The company has a 50 car freight yard at the foot of Grand street, Brooklyn, a yard at Thirty-seventh street and pier 27, East River, New York, also at pier 1, and a yard at the foot of Seventeenth street, North River. Bids for the new ferry slips and railroad station will be opened on Thursday, May 26, and the contracts awarded on Saturday, the 28th.

New Pipe Cutting and Threading Machines.

The engravings show a pipe cutting and threading machine of new design to be driven by belt power or by hand. The combinations of the different parts are simple, having few removable parts, combining in a compact form a good arrangement for cutting and threading pipe.

The power machine has the cone pulley at right angle to the ways. Though there are but two steps on the cone, four different speeds are secured by attaching the cone pulley and pinion to the shaft by a slip bolt.

The hand machine is so arranged that the relative speeds of the crank and the large gear driving the spindle may readily be changed, thus giving the operator whatever advantage of gearing may be necessary for the size of pipe being cut or threaded. This is done by changing the crank from one shaft to another, three such changes being provided for. Two cranks may also be used at the same time, one on each side, thus enabling two to work at the machine, though ample power is provided to enable one man to thread or cut 4-in. pipe.

The cutting-off head is arranged with a tool slide and self-centring V jaws to steady the pipe while being cut off. It is also arranged to use adjustable expanding or solid dies. The carriage with cutting-off head and die is moved by rack and pinion, worked by a hand wheel. The gripping chuck for holding the pipe is of the standard universal type.

At the rear end of the spindle, on the face of the large driving gear, is a two jawed, self-centring chuck to centre the pipe, doing away with bushings or guides.

The die shown in place on the machine is adjustable by the movement of a ring in which there are cam slots that operate to open and close the chasers for 2½ in. to 4 in. by a worm, 2 in. and smaller sizes by a lever as shown. The capacity of the machine is from ⅛ in. to 4 in. The makers are Messrs. D. Saunders' Sons, Yonkers, N. Y.

Improvements on Chicago Railroads for the World's Fair.

It is estimated that twenty-five or thirty millions of passengers will have to be carried into Chicago during the World's Fair, and the Chicago *Evening Post* has figured out that this will require an average of 14 heavy extra trains on each road every day during the six months the Fair is open. To prepare for this long continued rush it is estimated that $10,000,000 will be spent by the railroads in improvements, and the reporter has summarized the facts that lead him to this conclusion. His information seems to be authentic, though it is not written out with the precision desirable, and some of the orders for new cars and locomotives seem to be either exaggerated or premature. We copy the main portions of the article.

There are in Chicago six terminal stations used by the 20 passenger roads. These are the Central, the Chicago & Northwestern, the Union, the Grand Central, the Van Buren Street and Dearborn Street stations. They all occupy comparatively central locations and each is amply sufficient to meet all ordinary demands, but they are all except one admitted to be inadequate to meet the requirements of World's Fair business, and five of them will be enlarged.

The Central depot, at the foot of Lake street, now used by the Illinois Central, the Michigan Central, the C., C., C. & St. L. R. R. and the Chicago & West Michigan, will be abandoned. The Illinois Central's expenditures on account of the fair will amount to $4,000,000, though more than that may be required before all the work already undertaken is completed. One-third of the amount will be spent on the erection of a new passenger depot on the lake front at Twelfth street. This will be an attraction architecturally, and will be equal to all the demands that may be made upon it. The train shed, containing eight tracks, will be 126 ft. wide and 600 ft. long. The waiting-room will be 150 ft. long by 100 wide. The waiting-rooms, ticket offices and baggage-rooms will be on the street level. The building will be fireproof, constructed entirely of brick, stone and steel. It is understood that the suburban business of the Illinois Central will be handled from the present old depot at Randolph street. The other companies using these Lake Front stations have little or no suburban business.

Another part of the Illinois Central's work is the elevation of the tracks between Forty-seventh and Sixty-ninth streets. A block signal system is to be established between Randolph street and Sixty-seventh street. This road will order a large number of additional coaches and locomotives. The estimated cost of all improvements is as follows:

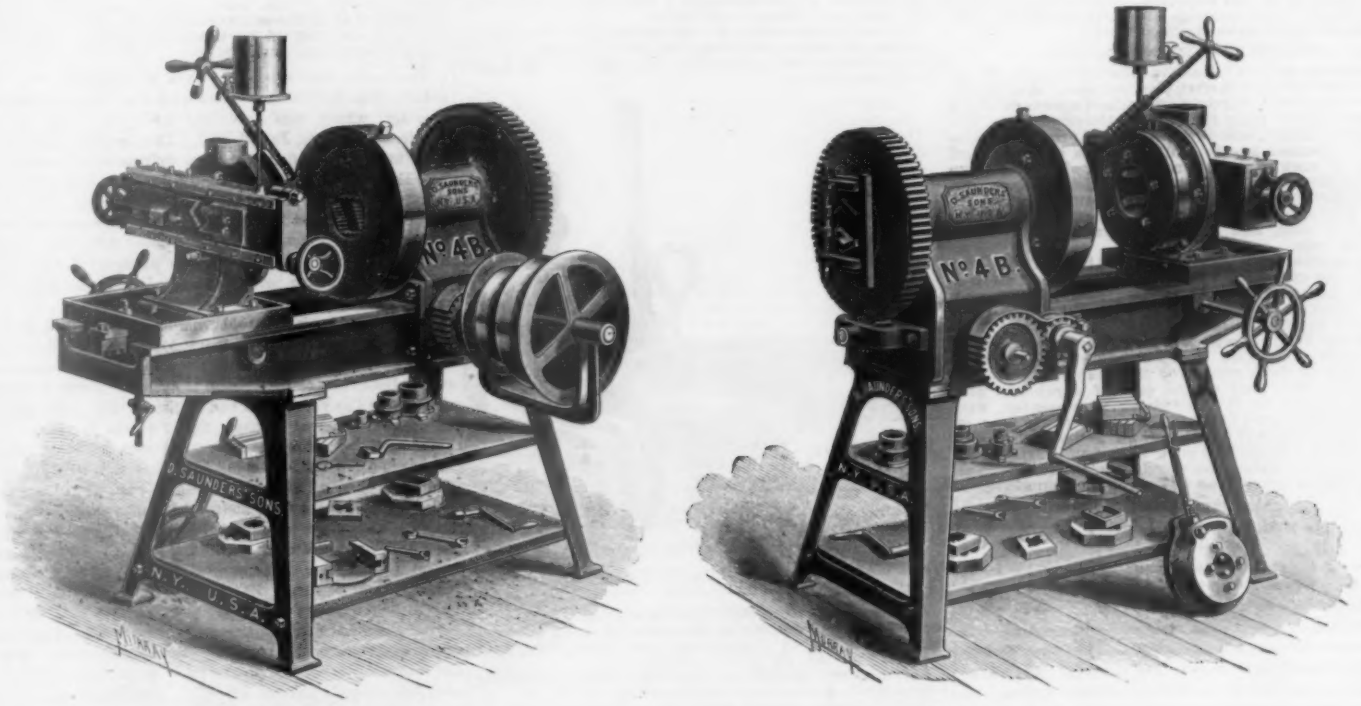
New depot	$1,000,000
Elevating track	842,000
Block signal and interlocking system	175,000
Additional tracks	30,000
Platforms, fences, etc.	27,000
Locomotives, 50 at $7,000 each	350,000
Passenger coaches, 500 at $3,500 each	1,750,000
Total	$4,174,600

It is estimated that these facilities will enable the Illinois Central to handle 21,000 passengers an hour. To do so it will have to run trains out every five minutes.

After the Illinois Central the Chicago & Northwestern will perhaps expend most. It is already actively engaged in the work and expects to spend $3,000,000 or more. A large part of this will be spent on second track outside of Chicago. When the fair opens the Northwestern will have virtually a double track from Chicago to the Missouri River. The most costly part of the improvements will be in Chicago. Among them is the doubling of the capacity of the Wells Street Depot and yards. The storage tracks for passenger cars will be moved west of the river, and the space now occupied by them is to be covered over for depot space. The present depot will be devoted to the through passenger trains, and the new space to be inclosed will be used for suburban trains. Fifteen new tracks will be placed under roof.

All other buildings will be moved west of the Kinzie street bridge. The express office building will be made into waiting rooms. A new five track bridge is to be constructed across the river at Kinzie street to replace the present double-track structure so that the frequent delays of trains will be avoided. The block system will be employed and the yards will be interlocked. The capacity of the gas house at Ada street, where the Pintsch gas used on cars is manufactured, is being doubled. Thirty-seven miles of second track are now being laid down near Chicago. New tracks are being laid from Desplaines to Barrington and from Spring Bluff to Lake Bluff. One hundred and twenty new passenger coaches and 60 new locomotives have been received.

At the Union Depot on Canal street, between Madison and Adams streets, extensive alterations and improvements have been decided on. This depot is used by the Pittsburgh, Fort Wayne & Chicago, the Pittsburgh, Cincinnati, Chicago & St. Louis, the Chicago, Milwaukee & St. Paul, the Chicago & Alton and the Chicago, Burlington & Quincy roads. The waiting-room and baggage-room capacity will be largely increased. A portion of the Fort Wayne freight depots east of the depot will be torn down and four additional tracks laid. Two of these will be set apart for the roads coming in from the North and two for those from the South. Additional relief will be afforded by the withdrawal of the Milwaukee & St. Paul's suburban business, which will be specially provided for at some point between Lake and Madison streets. The Burlington's suburban business will probably be withdrawn from the Union Depot and a suburban depot built at Harrison street. The changes to be carried out at this depot will probably cost $150,000.



Power Machine. Hand Power Only.

PIPE CUTTING AND THREADING MACHINES.

At Dearborn Street Station the Atchison, Topeka & Santa Fé, the Chicago & Erie, the Chicago & Grand Trunk, the Chicago & Eastern Illinois, the Louisville, New Albany & Chicago and the Wabash roads have their terminals. The six tracks in the depot will be increased to nine. The present baggage rooms are to be moved to Plymouth place. The yards will be located at Eighteenth street, where another station will be built and passengers for the south part of the city will be landed there. The ticket offices are now being rearranged and the space enlarged. The alterations and improvements, it is estimated, will cost about $35,000.

Three roads occupy the Van Buren Street depot. These are the Lake Shore & Michigan Southern, the Chicago, Rock Island & Pacific and the New York, Chicago & St. Louis. Extensive improvements are contemplated, although the details of the changes have not been formally decided on. They include additional tracks, the enlarging of the waiting-room and baggage-room and the general improvement of the depot building.

The Grand Central depot is equal to all the demands that can be made upon it. It is occupied by the Wisconsin Central, the Chicago, St. Paul & Kansas City, and the Baltimore & Ohio. It was opened a year ago, and is one of the largest and best equipped passenger stations in the country. Passenger trains can be received and sent out at least every five minutes. It is expected that 100,000 passengers a day can be handled without trouble or confusion.

EQUIPMENT OF THE ROADS TO BE IMPROVED.

All roads running into the city will increase passenger equipment by adding locomotives, baggage cars, chair and parlor cars. It has been an open secret for some time that the Nickel Plate is to be thoroughly equipped as a first-class passenger road between now and next spring. Not less than $3,000,000 will be spent in thus equipping it, and, in conjunction with the West Shore, an additional through route will be provided over it from New York.

The Michigan Central has ordered new equipment for through train service between Chicago and Buffalo. It is now turning out new passenger coaches every month from its shops at Detroit, and the Wagner shops are making new sleeping cars for its use. The Michigan Central will order 50 new passenger locomotives. Its expenditures on account of equipment will amount to something over $1,000,000.

The Big Four road expects to have independent tracks to the city limits before the opening of the fair. It now runs from Kankakee over the Illinois Central tracks. It may still use the terminals of that company, or possibly it may change over to the Grand Central Station. The

number of trains will be increased, and about 200 passenger cars will be added to the equipment.

The contemplated improvements on the Chicago & Alton approach $1,000,000. Most of this will be for equipment, and the balance will be expended on improving the terminal facilities. The Alton proposes to have baggage rooms of its own in addition to those furnished by the Union Depot Company. It is now negotiating for several buildings on Canal street, where all baggage not immediately called for will be stored. About 100 new passenger coaches, and from 25 to 50 locomotives will be added to the present equipment.

Orders have been given by the Burlington road for a large number of new cars and 50 locomotives.

The Chicago, Milwaukee & St. Paul road will expend about $2,000,000 for new rolling stock.

The Atchison, Topeka & Santa Fe will require about 100 additional cars and 50 locomotives. The estimated expenditure is $1,500,000 to $2,000,000 for improvements.

Five new vestibule trains have been ordered by the Chicago & Erie road, and contracts have been let for 75 passenger coaches and 28 locomotives. The cost of the whole will be over $1,200,000.

Rock Island officials have not finished their plans for the handling of World's Fair business.

The roads not mentioned, the Monon, the Eastern Illinois, the Wabash, the Grand Trunk, the Pennsylvania, the Lake Shore, the Panhandle, the St. Paul & Kansas City and the Wisconsin Central are not yet prepared to say just what they will do. The fact is, all the roads seem to be vying with each other to see which can do the most in this direction. If anything is wanting it will not be on account of the meagreness of railroad expenditures on the fair's account.

VISITORS TO BE WELL CARED FOR.

Arrangements have been made for taking care of the visitors on the most perfect plan possible. A company has been organized, the duly authorized agents of which will meet every train coming into the city. They will have lists of hotels, boarding houses and private families that will entertain guests and the rates of board and lodging at each of the different places. They will give the proper directions for reaching the different places and will contract for whatever accommodation may be required, so that a passenger may know exactly where he is going to stop, and what it will cost him before he leaves the train.

One or more central warehouses will be secured by the roads for the storage of unclaimed baggage, and all baggage not claimed within the 24-hour limit will be sent there. These warehouses will be divided up into compartments numbered from 0 to 9 consecutively, and each piece of baggage will be sent to the compartment which corresponds with the last figure of the check. For example, a check numbered 28,560 is presented. The baggage has been sent to the central warehouse and placed in division No. 0. The check is presented, and the baggageman goes to that division without loss of time, finds the piece of baggage, and delivers it to its owner. Each division will have as many subdivisions as there are roads using that warehouse, and the baggage will be piled up by roads as well as by final numbers.

Hydraulic Rail Bender.

We show a novel rail bender made by Messrs. Watson & Stillman, of New York, which seems to have some decided advantages over the screw benders. While it is somewhat heavier, it can be worked by one man and is more compact to handle and operate. The makers say: "Our experiments have shown that it was not the method of bending, but the long spacing which sprung the rail up, so that a very heavy hook to catch the web was not necessary."

The ram may be run in and out without pumping for a distance of 3½ in. This allows the tool to be placed over the rail and the ram brought up to its work on the rail head, when a few strokes will bend the rail to the desired curvature; it may then be slid along easily and another pressure given. The ram is graduated to show the spring of rail and has a loose steel head which fits the head of the rail which is being bent.

In a recent test in service two men bent forty 30-ft. 90-lb. steel rails in one day, where previously 20 had been the best work of six men with screw benders, and one rail was bent perfectly flat on 45 ft. radius in 1½ minutes on 16-in. centres of application.

The No. 4 bender weighs 275 lbs.

Standard Locomotive Tests.

The Committee appointed by the American Society of Mechanical Engineers to report on a "Standard Method of Conducting Locomotive Tests" has prepared a preliminary report. The action of this committee in this matter has been looked forward to with interest by all mechanical engineers connected with railroads, and it is generally expected that the recommendations of the Committee will be followed by those making tests in the future. The report is not quite what would naturally be expected of such a large committee, consisting of some prominent mechanical engineers, as it does not describe what would be strictly termed a method of conducting locomotive tests.

The work of this committee was divided into three sections, one having charge of the boiler tests, another the dynamometer car work, and the third the indicator work.

It was expected that this committee would discuss to some extent the comparative values of a shop and road test. As it is, nothing is said that would indicate the opinion of the committee on this subject. Considerable attention has been given in the last few years to the possibility of making shop tests of locomotives for the reason that such tests seem to be the only ones that can be made with anything like a uniform set of conditions, and it was hoped that the committee would take up the matter and dispose of it in one way or another as it is noticeable that there is a strong inclination on the part of several prominent roads to make shop tests instead of road tests for certain classes of investigation.

The report reads:

It is desirable, therefore, that locomotive tests be always made with a special train when possible, so that the same cars are used for the different trips, and the weight of train is uniform. The speed of the train can also be under control, and the tests not hampered by the rules governing a regularly scheduled train. Special and peculiar apparatus is employed by nearly every different experimenter as having some extra merit of convenience or accuracy, and we have endeavored to ascertain the best practical instruments and methods for the various measurements, and to illustrate or explain them.

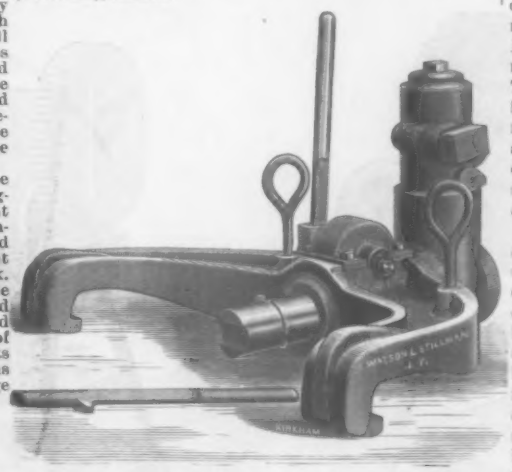
When a dynamometer car is not used: As a final basis of comparison of locomotives, we recommend as a unit the number of thermal units used per indicated horse-power per hour. The object in view in testing a locomotive will determine the methods employed and the extent and kind of data necessary to obtain. Some tests are made to ascertain the economy of a particular kind of boiler or firebox; others, the value of employing compound cylinders; others, to ascertain the relative merits of certain coals for locomotive use.

As a practical and commercial unit the amount of coal used per ton-mile may be used.

For a coal test we give a separate method and test blanks, Form *D*, for tabulating results:

For a unit of comparison of boiler test we recommend the number of thermal units *F* taken up every hour by the water and steam in the boiler.

For a measurement of the resistance overcome in hauling a train, a dynamometer car is essential, and we give a method of operating a dynamometer car and of recording results.



Hydraulic Rail Bender.

As a final unit for comparison for a complete test of a locomotive we recommend the thermal units of heat used per indicated horse-power per hour. The data necessary for this are given on Form C.

For a uniform method of recording results of indicator tests we recommend the blank Form A.

For tabulating general results Form B is presented.

In form "A" the water per indicated horse power and fuel per indicated horse power is intended to be recorded, but it is not stated how the indicated horse power per hour is to be determined in order to make these records.

It is also noticeable that no reference is made to the lost work during an application of the brakes. No fair comparisons can be made between the results of two tests if in one case the train has to be slowed down or stopped much more frequently than in the other.

The report recommends: "As a final unit for comparison for a complete test of a locomotive we recommend the thermal units of heat used per indicated horse power per hour." This is certainly a very satisfactory basis of comparison where the indicated horse power can be determined, but no one has yet devised any accurate method for getting the equivalent or true average of indicated horse power per hour of locomotive under actual running conditions, and we notice the committee has nothing to say about this; therefore, one may assume that we shall have to adhere to the old basis of coal per ton mile or perhaps thermal units per ton mile for the present. But this last basis is of no value except when the track and conditions are identical and we have no means of comparing locomotives tested under different conditions on different road beds.

The waste from the injector should be ascertained by catching it in a vessel conveniently attached (see fig. 187*) or by starting the injector several times in the engine house and catching the overflow in a tub.

The total weight of the water caught divided by the number of applications of the injector gives the average waste. The observer in the cab should keep a record of the number of times the injector is applied during the trips, and thus obtain data for estimating the total waste.

FUEL MEASUREMENTS.

The measurement of fuel in locomotive tests is not difficult so far as a determination of the total amount shoveled into the fire is concerned. A weighed amount may be shoveled into the tank, and the amount remaining, after a given run, be weighed to determine the amount used, provided no water is used to wet down the coal. But it is next to impossible to determine the amount of coal used at any particular portion of a run when the coal is put in the tender in bulk. If coal is put in sacks containing 125 lbs. each, with a small amount of weighed coal on the foot plate, even with heavy firing it is found quite possible for the fireman to cut open the bags and dump the coal on the foot plate as needed. In this way the rate of consumption on difficult portions of the run could readily be estimated. The use of water meters and of coal in sacks obviate any need of weighing the tender, and thus remove one of the largest inaccuracies incident to the ordinary locomotive tests. To determine the amount of coal used during the trip, it is only necessary to count the number of bags which have been emptied. However, the determination of the amount of fuel used during a run is not all that is necessary for a test. The measurement of the fire line before and after a test is very essential and extremely difficult. If the run is a long one, then the errors in the determination of the fire line may not be great; but for short runs there seems to be no way of measuring the difference between the heat value of coal in the fire before the test and after with sufficient accuracy to give reliable data. In tests made on a heavy grade, one trip closely succeeding another, it is of course impracticable to drop the fire and measure the amount of fuel in the ashes remaining. Such measurements are unsatisfactory and inaccurate in any case, because it is not practicable to draw the fire without wetting it, as the ashes rise into the machinery, and they are too hot to handle. When one run succeeds another within a short space of time, some other method is necessary for measuring fuel used than by dumping the coal.

The test is commenced with a good fire in the furnace, and the height of coal estimated by two or more assistants engaged in the trial. At the end of the run the fire should be in the same condition as near as possible. No raw coal should be in the box and steam pressure and pyrometer pressure falling.

The report shows several ways of applying the indicator. The first is that known as the Elliott indicator rigging, which was described and illustrated in the *Railroad Gazette*, Jan. 8, 1892. The second is the ordinary form of wooden segment driven by a pendulum. The third is the Dean indicator rigging, described and illustrated in the *Railroad Gazette*, Jan. 28, 1890. It is recommended that the indicator should be so piped that a steam chest diagram can be taken. Also that "indicator diagrams should be taken at equal distances instead of equal time intervals in order to properly average power."

The value of this last recommendation does not appear as it is evident that the average horse power generated could not be determined from indicator cards taken at equal distances for the reason that horse power is dependent upon the velocity of the engine, and at high speeds in a given interval of time there would be more indicator cards per minute than at low speeds. These cards, if averaged, would give a higher average horse power than was the real average during a run. For instance, on a ten mile run an engine might run five miles at a low speed with a very low horse power, perhaps as low as 100, and five indicator cards be taken. Suppose the speed then be ten miles per hour. This would occupy one-half hour of time. The remaining five miles might be run at 60 miles per hour, and there would be five cards taken with the horse power about 800. The time of passing the last five miles would be 5 minutes; hence, the locomotive would operate for 5 minutes at 800 H.P., and for one-half hour at 100 H.P., and the true average horse power would be 200.

But on the basis proposed there would be 10 indicator cards taken with an average horse power of 450. This 450 H. P. is the average horse power exerted at the different mile posts, and has nothing to do with the average horse power per hour, which is the information sought.

And further, while it is evident that a time interval between indicator cards is more satisfactory than a distance interval, yet it is questionable whether the time interval is best of all schemes. Probably it would be better yet to take indicator cards whenever the conditions change; that is, whenever the speed is altered or the position of the reverse lever or throttle is changed or the steam pressure is varied. In some classes of tests it may be difficult to do this, but on long steady runs it is quite possible. The accuracy of this last scheme appears from the fact that the indicator cards represent the entire power exerted by the engine, and the rate at which the power is developed at all times. While the speed and the steam pressure are constant, and the position of the reverse lever and throttle remain unchanged, it may be taken as practically correct that the shape and area of the indicator card will not change materially.

It is recommended that a revolution counter should be "so arranged that after starting out the instrument will continue to record the revolutions for a period of exactly one minute, starting every time from zero, and when the minute has elapsed the counter will stop." It is difficult to see what earthly use such an instrument would be on a locomotive, as within one minute's time the locomotive may change speed from zero to 30 miles per hour or vice versa. No revolution counter will ever be devised that will be of any practical value in determining the speed of a locomotive, while it may be made to answer all practical purposes for stationary engines. The instrument recommended is another one of those dangerous averaging instruments. An average of the speed during one minute's time on a locomotive while it is being accelerated or retarded is of no value when compared to the indications of such instruments as speed recorders and indicators, which give directly the speed at any instant.

It would also be very desirable to have an electric connection between the indicator instrument and the recording apparatus in the dynamometer car, so that at the instant an indicator diagram is being taken the

* This was given in the *Railroad Gazette*, Nov. 27, 1891, in the report of the Baltimore & Ohio tests.

fact is registered on the diagram paper in the dynamometer diagram, and the cards should be numbered consecutively, and the record likewise.

Besides the person taking the indicator diagrams, another person should be located in the cab of the engine, whose duty it should be to observe point-of-cut off given by the position of the reverse lever, the position of the throttle lever, and the boiler pressure, all of which conditions should be recorded in a log-book for this purpose.

Besides recording on the dynamometer diagram the fact that an indicator card has to be taken, a bell should be rung at the same time, so as to call the attention of the observers in the dynamometer car to this fact.

The general directions for testing locomotive boilers given in the report are as follows:

First.—The drawing of the boiler to accompany the report of tests should be particular in specifying the construction in detail, with reference to coal burning and generating steam, such as heating surface, grate area, and the distribution of openings through the grate, volume of firebox, size and thickness of flues, size of smokebox, and the arrangement for draft, together with the thickness of walls between the heating gases and the water in the boiler; the weight of the boiler itself should be given, and the number of cubic feet of water space and of steam space in the boiler, the division between the two to be taken at the middle of the range of the ganges.

Second.—Boilers for tests should be thoroughly cleaned on both sides of the heating surface, by a removal of the flues, before any test is commenced, and these surfaces should be kept clean by frequent washing during the test.

EXCEPTION.—When it is desired to make a comparison of boilers for the purpose of determining a difference between them as to incrustation, they should first be tested as above, when clean, and then tested again without further cleaning than the ordinary washing out of the boilers after the lapse of some months' service, which has resulted in the same evaporation per square foot of heating surface from both boilers, using the same water during that period.

Third.—In case the measure of the capacity of the locomotive boiler for generating steam be desirable, without reference to the engines forming the locomotive, this capacity should be measured by the number of thermal units, British, taken up every hour by the water and steam in the boiler, which may be readily determined from the observed data of temperature of water fed to the boiler, pounds of water evaporated per hour, and steam pressure under which this evaporation occurs, by using any good set of steam tables, such as Peabody's and that contained in Porter's book on Richard's Steam-Engine Indicator. In such cases it will be necessary to specify all the pertinent conditions under which such measure of the capacity of the boiler is made, so that in comparing with the capacity of another boiler all such conditions may be made as nearly alike as possible. It is, however, believed that a measure of the capacity of a locomotive boiler, without any reference to the capacity or efficiency and method of working of the *engines* which such boiler feeds on the locomotive, will not be of particular value in comparison of boilers, unless the conditions under which the engines are worked with different boilers are identical, or nearly so.

Fourth.—On account of the important influence which the temperature and, especially the moisture of the atmosphere, has upon the results obtained in a boiler test, it is necessary to compare two or more boilers at the same place and at the same time to get results which may be strictly comparable. The temperature of the air should then be noted for record.

Fifth.—To properly determine the amount of water fed to a locomotive boiler in service on a locomotive during any test, it is necessary to use a good water meter, which should have its maximum error determined by previous tests, and given with the report.

Sixth.—The coal used should be dry when weighed, and placed in sacks, each one containing 100 or 125 lbs., care being taken to insure that all scales used are accurate. When an unusually large amount of coal is needed a weighed quantity of coal may be placed in the front of the tender and used first, and the test finished with coal from the sacks. An analysis of the coal used should accompany the report, which should show the volatile matter, the fixed carbons, etc., the moisture, and the ash contained in the coal. The ashes should be dried if they contain any moisture, and carefully weighed and recorded after each test run.

Seventh.—The temperature of the smokebox gases should be measured by a good pyrometer, located near enough to the flues in the smokebox to get the average temperature of the gases after they have passed the heating surface, and before they are mixed with the exhaust steam. It is suggested that pyrometers, such as that offered by Schaefer & Budenburg, of Weiskopf, are suitable for this purpose.

Eighth.—The degree of exhaustion in the smokebox should be measured and recorded by means of a simple manometer gauge.

Ninth.—The quality of the steam furnished by the boiler to the engines should be determined by the most approved means, not yet determined upon by this committee.

Tenth.—Samples of gases passing from the flues to the smokebox should be analyzed and results reported. The means of taking such gases so as to insure perfect samples, is to be further considered by this committee, and definite means prescribed.

COAL TESTS.

Directions to be Observed in Supervising and Conducting Coal Trials.

The locomotive selected should be in good condition, and either a new engine or one that has lately undergone repairs.

The boiler should be washed before commencing the trial, the steam gauge tested the flues cleaned, and the exhaust nozzles cleaned and measured, which operations should be performed also whenever the kind of coal is changed.

Instructions must be given to roundhouse foremen that no repairs or alterations of any sort be made to the engine without the approbation of the conductor of the trial.

The engineman and fireman who operate the engine on the first trip should continue to operate the engine throughout the duration of the trial, and the same methods of firing and running should be strictly preserved.

The run selected must be one on which the same distance is covered on each trip.

The trains must be through trains and unbroken from end to end of the run, and the same number of cars and same lading should be provided each trip.

The same speed should, if possible, be preserved on all trips.

The conductor of the trial must be a person familiar with correct methods of firing and running locomotives, and must insist that the fireman adhere to well recognized good methods of firing, and that the same method be preserved throughout the duration of the trial, so that all coals shall receive the same treatment.

He must also see that the coal supplied at coaling points is of the proper kind, and must weigh the coal personally, and keep an accurate record of the following items:

The coal consumed. The amount of ash. The amount of cinders in smokebox. The water evaporated. The number of cars in train. The weight of cars as marked thereon. The weight of lading. The state of the weather. The direction and estimated velocity of wind. The temperature of the atmosphere. The temperature of the feed water. The time on road. The steam pressure. The exhaust nozzles.

The conductor should enter the above observations in a log-book, together with notes of repairs to engine, and any other items that would be of import.

REPORT OF COAL TRIALS.

In order that coal trials may be similar and consequently comparative, the following data must be preserved in their compilation:

First.

Dates between which trials were conducted. Class of locomotive. Service in which trials were made, mentioning locality, etc. Name of conductor of trial.

Second.

Coal A.—Kind of coal. Name of mine and operator. Location of mine. Physical quality of coal (appearance). Steaming quality of coal. Kind of fire made. Clinkers and ashes. Cinders in smokebox. Cleaning ash pan and smokebox. Labor involved in firing.

Coal B.—Same as above.

GENERAL REMARKS.

Comparison of evaporation (pounds of water evaporated per pound of coal). Comparison of coal consumed per 100 tons hauled one mile. Value coal A, 100 per cent. Value coal B. Comparative value. Coal A is 100 per cent. more or less valuable than coal B.

A table of engine performance and a table of general results of engine performance for each coal must accompany the report.

Pyrometers of the form recommended are described in the *Railroad Gazette*, Nov. 27, 1891, in the report of the Baltimore & Ohio tests. It is recommended that they should register up to 1,200 degrees F., but this is not high enough, as in some tests recently made the brass tube of the pyrometer was nearly up to the melting point. The location of the pyrometer, as shown in the illustration accompanying the cut, is outside of the diaphragm about 12½ in. from the tube sheet. This, perhaps, is not a proper place to get the reading that is wanted. What is desired is the temperature of the gases as they pass away from the heating surface of a boiler before they are expanded into the smokebox. That temperature can only be obtained by putting the pyrometer inside of the deflecting plate between it and the ends of the tube so that the temperature can be taken before the gas has expanded and thereby cooled. It may be that more than one pyrometer would be necessary to get a fair average.

Three kinds of water measuring apparatus are referred to in the report: The water meter, the float in the tank, and the water glasses on the sides of the tank. The arrangement and type of water meter illustrated in the report is the same as that described in the *Railroad Gazette*, Nov. 27, 1891, as used on the Baltimore & Ohio tests. In the report the float in the tank is considered as preferable to the water glasses. We believe the first practical and successful use of a water meter in a locomotive test was made on the Baltimore & Ohio Railroad in the tests above described. The meter used was the Thompson water meter, which since that time has been very successful in locomotive work. It is now being used on six different roads in making tests to compare simple and compound locomotives.

The report recommends the following as necessary to be observed in measuring the water level in the boiler.

"When locomotive boilers are being fired hard the water rises above the normal level, and a measurement of water just after the injectors have been throwing comparatively cold water into the boiler is not an accurate one; the water shrinks and swells according as the firing is hard or as the locomotive is being worked. Hence measurements taken under these variable conditions are necessarily approximations. There is also a continuous movement of the water in the water glass, and a mean of the oscillations is not quite satisfactory. Although the amount of water fed into the boiler can be determined exactly by the use of meters, yet the inaccuracies of the location of the water line render water measurements on short runs almost impracticable. The six-hour test for a stationary engine is considered satisfactory when successive tests will give the same results; but in locomotive work, unless the engine be kept quiet, as it would be when tested in a shed, a short test is of little or no value. It may be accepted that a determination of the water line by the sound of the gauge cocks is too uncertain to be admissible in locomotive tests unless the run is a long one. In such cases the total amount of water used is so large that any errors in estimating the water level at the beginning or the end of the trip practically disappear.

A locomotive which is undergoing a test should have a water-glass on the boiler. Behind this should be a piece of wood graduated; and surrounding the glass and fastened to the wood should be a copper wire at the height at which the water should be left at the end of every trip. The tank measurement should not be taken at the end of the trip until the water in the boiler is at the standard height. The temperature of the water should be taken as it enters the tank at every station where water is taken, and tank reading should be taken before and after each filling.

Leakage of Boiler.—To test this, keep up as nearly as possible, without blowing off, the pressure to be carried, and note the fall of water in the water-glass in a given time, say four hours. Of course the injector must not be applied during this interval. The water meter can then be used to determine the amount lost by leakage by reading the dial, applying the injector until the water reaches the original level, and then taking a second reading. The difference will be the amount of water lost. All boilers lose more or less from this cause, and if the test is to be a comparison between two different styles, the necessity for this information is obvious.

Before beginning a test, the pistons, slide and throttle valves of the engine should be made tight. The point of cut-off for each notch of the quadrant should be ascertained, and the cut-off should be painted in white on the quadrant, or on boiler jacket, with pointer or lever. All leaks about the engine should be stopped.

A graduated scale and index should be attached to the throttle so as to indicate its opening.

A special steam gauge with a long siphon should be used for the boiler pressure and attached to the front of the cab at the left side, so that it will not become incorrect from overheating. Readings of the gauge, reverse quadrant, throttle scale and boiler height scale should be taken frequently, the first as often as once in two and one-half, five or ten minutes, depending on length and character of run, and all with each indicator diagram, if the latter are being taken.

Just before beginning a trip the water in the boiler should be at the standard height and the tank reading taken in order to ascertain the amount of water used while running, or per indicated horse-power per hour.

Extraordinary efforts should be made to prevent blowing off before train time and while running. The number of times and the length of time safety-valve is blowing off should be recorded.

No water should be taken from the tank for any purpose except supplying the boiler, and the boiler should not be blown off during a test if it can be avoided. If it cannot be avoided, the water should be at the standard height before and after blowing.

DYNAMOMETER RECORDS.

The dynamometer for measuring the resistance of the train, exclusive of the engine and tender resistance, should be able to record the following data:

"A."—The pull upon the drawbar.

"B."—The speed at which the train is running.

"C."—The location of any point along the line used for reference stations, and possibly "D," the wind resistance.

"A."—THE PULL UPON THE DRAWBAR.

The force required to move the train or the pull upon the drawbar should be registered upon a strip of paper traveling at a definite rate per mile of distance traveled over by the train; the scale upon which this diagram is drawn should be as large as is possible with any reasonable limits; a scale of ¼ in. per 1,000 lbs. pull is probably as suitable as any that can be devised, and the maximum registered pull need hardly exceed 28,000 or 30,000 lbs.; the height of the diagram should be measured from a base line drawn upon the paper by a stationary pen so located that when no force is exerted upon the drawbar, the base line should coincide with zero pull.

"B."—THE SPEED AT WHICH THE TRAIN IS RUNNING.

This record should, if possible, be obtained in two ways:

First.—By an accurate timepiece, preferably a chronometer furnished with an electric circuit-breaking device. It is of considerable importance that the timepiece should have its circuit-breaking device very carefully made, to produce exact intervals of time marks, because, when the matters of acceleration or retardation of speeds enter into the data required, it is important that the time record should be correct. The question of length of intervals of time required is open for discussion. In most cases of ordinary work, five seconds intervals, or 12 to the minute, is probably as satisfactory as can be decided upon; for very careful work it would probably be advisable to have an auxiliary apparatus, something like the Boyer Speed Recorder.

Boyer Speed Recorder Diagram.—Its accuracy and reliability is without question when the device is properly mounted and cared for. It is not a delicate machine, and only needs ordinary attention. Its operation is well known to most of our members. It consists of an oil pump which works against a fixed resistance in the shape of an aperture through which the oil flows. The faster the pump runs, the greater is the pressure in the oil cylinder. A piston in the oil cylinder which moves against a spring rises in proportion to the increase of pressure. As the piston rises, a metallic pencil marks the movement on a roll of prepared paper, which moves in proportion to the longitudinal movement of the engine. In the cab is a dial which indicates at all times the speed of the engine with only a small error. The diagrams record all stops and make an accurate record of the rate of acceleration.

Second.—It would be very desirable to have, in addition to the apparatus just described, another one which produces a continuous curve upon the diagram paper, the ordinate of which, measured from a base line, would give the speed in feet per second, or any other convenient measurement; this could be obtained by modification of the Boyer's speed indicator.

"C."—THE LOCATION OF ANY POINT ALONG THE LINE USED FOR REFERENCE STATIONS.

These location marks are most easily produced by having, at various convenient parts of the car, electric press buttons, and having a pen upon the dynamometer, which will be deflected sidewise when the circuit is made or broken; this pen to be operated by an observer whose special duty is to attend to this part of the work.

"D."—WIND RESISTANCE.

Very little attention has so far been given to measurements of wind resistance, or the relation it bears to the frictional resistance of journals and wheels, and few experiments on this subject are recorded. The subject is very complex, owing to the fact that it is generally supposed, and we think with good cause, that the train is so very largely surrounded by eddies of air, and that it will be very difficult to obtain any reliable data, especially when it is remembered that the clearances of a railroad are greatly circumscribed and reduced to a minimum, so that it will be impossible to put any apparatus which measures resistance of this kind far enough out from the car to get reliable data. The apparatus for measuring this resistance would probably be subdivided into three separate discs, one facing front and two facing toward the sides of the car, all three connected together to produce a single resultant curve drawn upon the diagram paper, and the scale upon which this is drawn could probably be best subdivided into ten points, as practiced by the United States Government.

The measurement of wind resistance is propably more

interesting to railroad engineers than almost any other resistance of railroad trains. All feel uncertain about the amount which this resistance affects the speed of trains, and it is to be regretted that no definite recommendations are made about the apparatus to be used for tests of wind resistance in this report. However, as this is a preliminary report, we may yet hope to find it in the final one.

The following is given about calorimeters for measuring the dryness of the steam.

There is little doubt that the superheating or throttling calorimeter will fulfill all requirements for testing the dryness of steam in locomotives. It cannot measure quantitatively more than about five per cent. of moisture, but it appears probable that locomotive boilers develop steam which either contains a fraction of one per cent. of moisture, or the priming is a sudden temporary action, causing water to mix with the steam to such an extent that no quantitative measurement of its amount is practicable. Under these circumstances all that is desired of a calorimeter is to indicate the temporary occurrence of this sudden excessive priming, and a throttling calorimeter has been shown by Mr. D. L. Barnes to be capable of doing this, provided the thermometer has its bulb in direct contact with the steam flowing through the calorimeter. Such an arrangement is shown in the accompanying figure, of which the following is a description abstracted from the *Railroad Gazette* of Nov. 27, 1891.

Calorimeter.—This instrument consisted of two pieces of brass pipe, one inside of the other, leaving an air space between the outer and the inner. The outer pipe was screwed into the dome, and extended within the dome to the throttle. At this interior end the two pipes were joined together by a cap which had a perforation $\frac{3}{32}$ of an inch in diameter. On the outer end of the inner pipe was placed a globe valve, and next to this and outside of it a tee in which was a stuffing box and a thermometer, as shown by the sketch herewith. Beyond this tee was another globe valve and a short pipe of a large diameter to carry the steam jet away from the man in charge.

With this device the point of most rapid movement of the steam was located next to the throttle, and any water coming near it would immediately pass through the opening, because of the high velocity. The thermometer bulb was bared to the steam, and no cups were used. It was found passible to shut off the outer globe valve and expose the thermometer to a full boiler pressure without blowing the thermometer from the stuffing box. In this way it was determined that the thermometer recorded a steam temperature which corresponded to the steam gauge in the cab.

With this instrument priming was shown whenever the boiler was filled to a point where water could be seen coming from the stack: Immediately when the boiler foamed, the thermometer in the second calorimeter dropped to 212 degrees. It is believed that this calorimeter is more accurate for locomotive work, because it often happens that the locomotive primes only at starting and not for a sufficient length of time to enable the Barrus instrument to make a true record. And again, there are in a locomotive rapid changes in the rate of steam use which must cause rapid changes in the wetness of the steam.

The questions yet to be settled regarding the instrument are:

First, From what part of the interior of the boiler it should draw its steam?

Second, Can the thermometer be located in the cab?

We think it probable that the pipe leading from the interior of the boiler can be steam-jacketed so as to maintain the steam carried to the throttling valve of the calorimeter at boiler pressure, but a trial of such an arrangement has yet to be made.

We think, also, that calorimeters must draw steam both from dome and from the pipe carrying steam to the cylinders nearly at its exit from the boiler, in order to determine fully the performance of the boiler as a generator of dry steam. Of the two locations, we regard the end of the steam pipe as best fitted to represent the quality of the *average* output of steam.

As stated at the beginning, this is a preliminary report, and is subject to revision.

In our final report we expect to include some of the results obtained in shop tests of locomotives by Professor Goss, and some comparative tests of simple and compound locomotives.

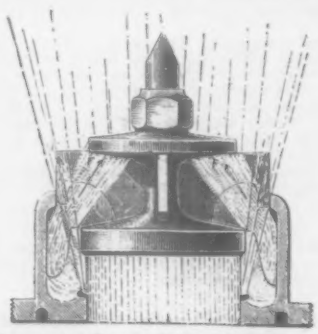
We have referred in this review to some tests made on the Baltimore & Ohio Railroad, and published in the *Railroad Gazette* Nov. 27, 1891, not because they are the most accurate or the most extensive that have been made, as they are not. The dynamometer car was not available, and the conditions were not such as to permit of a degree of accuracy such as is desirable for locomotive tests. However, what was sought in those tests was obtained and a decision reached. What we refer to in those tests is the apparatus used, it being, we believe, except for the dynamometer car, the most complete used for a locomotive test up to that time. Since then the Chicago, Milwaukee & St. Paul have made and are making tests with the apparatus as used on the Baltimore & Ohio, with several important additions by Mr. Geo. Gibbs, the Mechanical Engineer of the road. The B. & O. engines were equipped with two Thompson water meters, a Boyer speed recorder with special attachment for marking mile posts and indicating any desired point on the line, a revolution counter for the drivers, a stroke counter for the air pump, two pyrometers in the smokebox, a superheating calorimeter in the dome, indicators with steam chest connections, thermometers for determining the steam heat and pressure, graduated tank glasses, graduated water line glasses for the boiler, electric bells and speaking tubes. The fuel was kept in bags containing 125 lbs. each, and opened by the fireman as wanted. An endeavor was made to make a true record of the average horse-power of the locomotives, and indicator cards were taken whenever the conditions changed. In that way a nearly true average indicated horse-power was probably obtained from those tests. Of course, the apparatus on the B. & O. was not made to work without a great deal of trouble and preliminary experiment, and to the perseverance of those making the tests is due the completeness of the records obtained. The tests were made by the *Railroad Gazette* to determine two things: 1st, the power of the engine, which was a Baldwin of unusual capacity, and 2d, to ascertain how far it was possible to make a complete locomotive test under actual running conditions by using the best known apparatus. The tests were conducted by Mr. F. I. Cole, mechanical engineer of the Baltimore & Ohio Railroad, and Mr. D. L. Barnes of the *Railroad Gazette*.

WILLIAM FORSYTH, Chairman,

F. W. DEAN,	ALLAN STILING,
J. W. CLOUD,	J. E. DENTON,
A. S. VOGT,	R. H. SOULE.

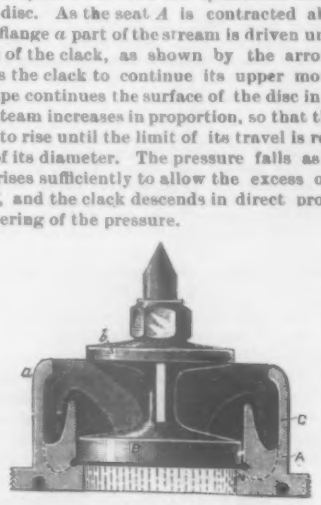
Some German Notions.

The Engineer (London) of March 25 gives some interesting notes on the Luxemburg railroads. Among other things mentioned is a progressive escape safety valve in use on the Prince Henry Railroad. This is shown in the two sections. When the pressure is about at its maximum limit, the clack *B* rises slightly and the valve blows off. If the pressure is not sufficiently reduced the clack continues to rise and the steam escapes freely by



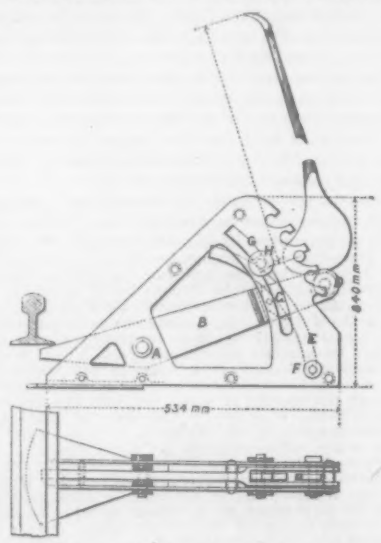
Progressive Escape Safety Valve—Open.

the annular space *C* between the cylindrical seat *A* and the upper disc. As the seat *A* is contracted above by the curve flange *a* part of the stream is driven under the upper disc of the clack, as shown by the arrows *F F*. This forces the clack to continue its upper movement. If the escape continues the surface of the disc in contact with the steam increases in proportion, so that the clack continues to rise until the limit of its travel is reached; this is ¼ of its diameter. The pressure falls as soon as the clack rises sufficiently to allow the excess of steam to pass off, and the clack descends in direct proportion to the lowering of the pressure.



Progressive Escape Safety Valve—Closed.

Another device used by the same company is the track jack shown in the engraving. It is said that with this jack a man can lift six tons, and there is no danger of slipping. Two steel plates in the form of a sector are bolted together, with distance pieces between them. At the point is a shoe to prevent the jack sinking into the ballast. Between the plates and pivoted at *A* is the lever *B*, which is forked at its outer end, where it carries a hardened steel roller *D*. Near the spring of the fork is pivoted a tumbling block *C*. The outer side of this is struck to the same radius as the curved arm *E*, which is



Track Jack—Luxemburg Railroads.

pivoted at *F*, and is eccentric to the curved slot *G* in the plates. In this slot works the block *H*, kept in position by washers, which, though of rectangular section, act as a wedge between the curved arm and the outer arc of the slot. The locking action of the block is communicated by the curved arm and the tumbler to the beam. The outer periphery of the sectors is notched to receive the pivot of the hand lever which works on the track lifting lever through the roller *D*. As the rail is lifted the sliding block, acting by gravity, constantly locks the lever *B* in position through the curved arm and tumbler, and the hand lever may be taken out at any point.

Train Accidents in the United States in April.

COLLISIONS.

REAR.

1st, on Ohio & Mississippi, near Lebanon, Ill., a construction train running with the caboose foremost ran into the rear of a freight train which had stopped to do some switching. Both cabooses and 3 flat cars were wrecked, and 2 trainmen and 7 employés injured.

2d, on Chicago, St. Paul, Minneapolis & Omaha, at Apex, Neb., a freight train ran into the rear of another freight at a curve, wrecking the caboose and one car, which caught fire and were burned up. Three trainmen injured.

5th, on Burlington & Missouri River, at Yuma, Col., an eastbound train approaching the station broke in two. It seems that the rear portion, which apparently had no air brakes upon it, was being allowed by the trainmen to follow the front portion; but the engineer put on the brakes with full force, and the rear portion crashed into the forward one, wrecking a number of cars. The conductor, who was in the caboose, was injured.

5th, on Fitchburg road, at West Acton, Mass., a freight train ran into the rear of another freight, damaging engine, caboose and 3 cars. A boy riding in the caboose was injured.

16th, on Louisville & Nashville, near Elmore, Ala., a freight train broke in two and before a following freight could be flagged a collision resulted, in which one locomotive and several cars were damaged and three trainmen slightly injured.

17th, on Rome, Watertown & Ogdensburg, at Watertown, N. Y., a standing freight train was run into by a following freight, which approached at unchecked speed, all the men on the engine having fallen asleep. A number of cars were wrecked and burned up.

21st, on Baltimore & Ohio, near Salisbury Junction, Pa., an emigrant train which had stopped to do some switching was run into at the rear by a following freight train, considerable damage was done and 6 passengers injured, one of them probably fatally.

25th, on Cleveland & Pittsburgh, in Cleveland, O., a freight train ran over a misplaced switch and into some box cars standing on a siding. The engine and tender were overturned and the following cars were piled over them. Engineer severely scalded.

26th, on West Shore road, at Tompkins Cove, N. Y., a freight train ran into the rear of another freight, damaging an engine, caboose and 4 cars. One trainman slightly injured.

28th, on San Antonio & Aransas Pass, near Evergreen, Tex., a passenger train ran into the rear of a freight train which had stopped to do some switching, doing slight damage. The fireman was seriously injured by jumping.

28th, on Louisville & Nashville, at Moore's, Ky., an accommodation train standing at the station was run into at the rear by a freight train, badly damaging the rear coach and the colliding engine. A fireman and a man stealing a ride were killed and the engineer severely injured.

30th, on Pennsylvania, near New Brunswick, N. J., a freight train ran into the rear of another freight, wrecking the caboose and a number of cars and killing 19 horses. A tramp was killed and a brakeman and 2 tramps were injured. The caboose and one car caught fire and were burned up.

30th, on Maryland Central, near Sharon Springs, Md., a passenger train ran over a misplaced switch and into a flat car standing on a sliding, doing slight damage. Engineer and conductor slightly injured.

And 7 others on 6 roads, involving 2 passenger and 8 freight and other trains.

BUTTING.

4th, on Colorado Midland, near Leadville, Col., collision between a snow plow engine and a freight train, damaging both engines and several cars. Three trainmen injured.

5th, on Chicago & Northwestern, near Waukesha, Wis., butting collision between a passenger train and a freight, in which 4 trainmen were killed.

7th, on Cleveland, Akron & Columbus, near Summit, O., butting collision between a passenger and a freight train, due to a flagman's neglect in not holding the former at the preceding station. The engines and forward cars in each train were badly damaged. Engineer and 5 passengers injured.

19th, on New York & New England, at Black Rock, Conn., butting collision between westbound passenger train No. 23 and the eastbound Long Island Express, due to one of the trains moving from double to single track against the rules. Both engines were badly damaged, as were also a number of the foremost cars. One trainman injured.

23d, on Chicago & Grand Trunk, near Lapeer, Mich., butting collision between a freight train and an empty engine, due to a misunderstanding of orders, wrecking both engines and a number of cars. One trainman killed and another badly injured.

25th, on Milwaukee, Lake Shore & Western, at Ramsay, Mich., butting collision between a passenger train and a switch engine, both moving at considerable speed, wrecking the locomotives and damaging the ends of several coaches. A fireman was killed and an engineer injured.

26th, on Cahaba Coal & Mining Co.'s road, near Blocton, Ala., butting collision between an Alabama Southern passenger train and a Louisville & Nashville freight, due to a dispatcher's mistake. Both engines and 9 freight cars were wrecked. Engineer, fireman and 2 passengers injured.

And 4 others on 4 roads, involving 1 passenger and 6 freight and other trains.

CROSSING AND MISCELLANEOUS.

6th, on Chicago & Northwestern, at Wales, Wis., collision between a freight and an empty engine, derailing several cars and injuring 2 trainmen.

16th, night, at the crossing in Monticello, Ill., a Wabash freight train ran into an Illinois Central freight, wrecking a number of cars. Two men standing near the track were caught in the wreck and killed, and another bystander was severely injured. There was a fog at the time.

16th, on Michigan Central, near Bay City, Mich., a passenger train ran over a misplaced switch and into a yard engine standing on a siding, damaging both locomotives and an express car. The engineer of the switch engine was badly injured.

23d, on Maine Central, at Bemis Station, Me., a freight train entering the yard was not properly controlled and collided with a standing freight, damaging two engines and several cars. An engineer was injured by jumping.

28th, on New York Central & Hudson River, at Adams Basin, N. Y., a freight train ran over a misplaced switch and struck some cars which were being unloaded on a siding, killing a boy. Engine and several cars damaged.

And 11 others on 11 roads, involving 2 passenger and 20 freight and other trains.

DERAILMENTS.

DEFECTS OF ROAD.

3d, on St. Louis, Iron Mountain & Southern, near Sabula, Mo., 6 cars of a freight train broke through a trestle which had been weakened by a freshet. A brakeman was killed and several other trainmen slightly injured.

7th, on Illinois Central, near Milan, Tenn., a trestle broke down under a freight train and 8 cars of bananas fell into a creek. The conductor was badly hurt and a man in charge of freight was pinned down by a stove and fatally injured.

And 5 others on 5 roads, involving 1 passenger and 4 freight and other trains.

DEFECTS OF EQUIPMENT.

8th, on Pittsburgh, McKeesport & Youghiogheny, near Connellsville, Pa., the engine of a freight train was derailed and wrecked by the breaking of a tire. The fireman was killed and the engineer badly hurt.

8th, on Cleveland, Cincinnati, Chicago & St. Louis, in Marion, O., six cars of a freight train were derailed by the dropping of a brakebeam. A switchman was thrown to the ground and injured.

22d, on Union Pacific, near Colfax, Wash., the flange of a locomotive wheel broke on a curve, derailing the engine and baggage car. The former was overturned and badly damaged, injuring the engineer and fireman.

22d, on Lake Shore & Michigan Southern, near Silver Creek, N. Y., the caboose and several cars of a freight train were derailed and damaged by the dropping of a brakebeam, two trainmen being injured.

28th, on Ohio River road, near Wheeling, W. Va., the caboose of a freight train was derailed and thrown over an embankment by the dropping of a brakebeam, slightly injuring the conductor and his wife.

30th, night, on the Pennsylvania, at Coatesville, Pa., a number of cars on an eastbound freight train were derailed by the breaking of an axle, part of the wreckage fouling the westbound track and derailing the locomotive of an express train passing at this juncture. The derailed engine went over a high embankment, killing the engineer and fireman. Twelve freight cars were burned up.

And 12 others on 11 roads, involving 1 passenger and 12 freight and other trains.

NEGLIGENCE IN OPERATING.

6th, on Central of New Jersey, at Bayonne, N. J., a yard engine was derailed and overturned by running over a sharp curve at too great speed, killing a brakeman.

9th, on New York, Lake Erie & Western, at Mountain View, N. J., a passenger train ran over a misplaced switch, and the engine broke away from the cars and went down a bank. The engineer was severely injured, but the fireman escaped by jumping.

21st, on Montana Union, at Buffalo, Mont., a freight train was derailed by a misplaced switch, the locomotive being upset and a number of cars derailed. A brakeman was badly injured.

And 13 others on 11 roads, involving 5 passenger and 8 freight and other trains.

UNFORESEEN OBSTRUCTIONS.

1st, on Burlington & Western (narrow gauge), 40 miles north of Burlington, Ia., a passenger train was blown from the track by high wind and considerably damaged, the baggageman, a mail clerk and 2 passengers being seriously injured.

2d, on Fall Brook Coal Co.'s road, near Tiadaghton, Pa., a freight train ran into a landslide, wrecking the engine and 14 cars. A brakeman was severely injured by jumping.

3d, on Chesapeake & Ohio, near Ronceverte, W. Va., a freight train ran into a rock which had fallen upon the track, the engine being thrown into a river and a dozen cars badly damaged. Engineer, fireman and brakeman killed.

3d, on Northern Pacific, near Grand Forks, N. D., a freight train ran into a washout, the engine and 2 cars being ditched and wholly submerged. The fireman was drowned.

4th, on East Tennessee, Virginia & Georgia, near York, Ala., a freight train ran over a cow and 6 cars were derailed and damaged. An employé was injured.

7th, on Denver & Rio Grande, near Grand Junction, Col., a passegger train ran into a rock which had fallen upon the track, the engine being derailed and thrown into a river.

21st, evening, on Little Rock & Fort Smith, near Blackfish, Ark., a passenger train was derailed at a point where the roadbed had been impaired by a freshet. The engine, baggage car and 2 coaches went over an embankment, one of the latter lodging roof downward in a river. Many passengers were bruised but none of them was badly hurt.

25th, on Gulf, Colorado & Santa Fé, near Alvin, Tex., a freight train was derailed by high wind, the engine being overturned and 12 cars wrecked. Four trainmen slightly injured.

26th, on Southern Pacific, 26 miles east of Yuma, Ariz., the engine and two forward cars of an eastbound passenger train were derailed and ditched by running into a herd of cattle. Fireman killed and 4 other trainmen injured.

28th, on Illinois Central, near Kenneville, La., a freight train, the engine of which was running tender first ran over a cow, and the locomotive and 6 cars were derailed and wrecked. Three men in charge of freight were killed.

29th, on Southern Pacific, near Myrtle Point, Or., a northbound express train was derailed by ties which had been maliciously placed upon the track, the locomotive, mail and express cars being ditched, injuring the engineer and fireman and a tramp riding between the cars.

And 3 others on 3 roads, involving 0 passenger and 3 freight and other trains.

UNEXPLAINED.

4th, night, on Illinois Central, near Grenada, Miss., the rear car of a passenger train, carrying officials of the Chicago, Milwaukee & St. Paul, was derailed and turned over on its side, slightly injurying 5 of its occupants.

8th, on Atchison, Topeka & Santa Fe, near Purcell, I. T., a freight train was derailed and partially wrecked, the conductor being seriously injured.

20th, on Ocean View Railroad, near Norfolk, Va., a car of a passenger train was derailed and damaged, injuring 1 passenger and several employés.

21st, on Lehigh Valley, at Shamokin, Pa., about a dozen cars of a freight train were derailed, some of them going through the brick wall of an adjacent iron foundry.

22d, on Union Pacific, near Garfield, Wash., a passenger train was derailed and the engine wrecked. Engineer and fireman injured.

22d, on Missouri Pacific, near Nebraska City, Neb., the engine and forward cars of a passenger train were derailed and wrecked. The fireman was scalded to death and the engineer probably fatally scalded.

26th, on Baltimore & Ohio, near Grafton, W. Va., the forward portion of a passenger train was derailed and damaged. Engineer killed.

26th, on Baltimore & Ohio, near Kingwood, W. Va., the forward part of a passenger train was derailed and wrecked. The locomotive was thrown over on its side, killing the engineer. Fireman and baggageman severely injured.

28th, on Missouri Pacific, near Independence, Mo., the caboose and 3 cars of a freight train were derailed and went over an embankment. Conductor and brakeman injured.

29th, on Great Northern near Bonner's Ferry, Wash., a construction train carrying 300 laborers was derailed and thrown over an embankment into a river. Three of the men were killed and 30 injured, 3 of them probably fatally.

And 21 others on 20 roads, involving 4 passenger and 17 freight and other trains.

OTHER ACCIDENTS.

4th, on Illinois Central, near Grand Crossing, in Chicago, the engine of a passenger train was wrecked by the explosion of its boiler; the engineer and fireman were injured.

6th, on Long Island road, near Blissville, N. Y., an engine of a passenger train was partially wrecked by the bursting of the crown sheet. Two trainmen killed and 2 trainmen and a boy injured.

26th, on Minneapolis, St. Paul & Sault Ste. Marie, at Whitedale, Mich., a locomotive was wrecked by the explosion of its boiler, killing the fireman and seriously injuring the engineer.

28th, on Colorado Midland, in a tunnel near Colorado City, Col., about 50 ft. of tunnel roofing fell upon the engine and several cars of a freight train. The engine cab was crushed, killing the engineer and injuring the fireman.

And 6 others on 6 roads, involving 4 passenger and 2 freight and other trains.

A summary will be found in another column.

The Steam Distribution in a Form of Single Acting Compound Engine.*

BY. F. M. RITES.

This paper will consider the engine as an economic study only, the steam distribution being entirely independent of single-action or other mechanical features.

It is necessary to note briefly the character of previous work to understand properly the nature of the departure made in this new type of compound. Broadly stated, all compound engines, with this single exception, may be considered under two heads: those having an intermediate receiver between the cylinders, each with a complete valve, or system of valves, interposed between it and the receiver, and those (known as the Woolf) having no such receiver, but so designed that a port shall periodically act as a passage between the cylinders.

All the energy of inventing engineers since the design of the first compound has been expended in the development of these two forms. The patent records are, perhaps, the best indication of the amount of thought given to the subject; and the almost unending claims, based on the arrangement of cylinders either in tandem or side by side, with cranks in line or at angle, oscillating or otherwise, and with valves from one to eight in number, are but variations upon the fundamental principles which distinguish one type from another.

Of the two types, the receiver is better known, although it is necessarily the more complicated. The general choice may be explained by the fact that each cylinder may be treated by the designer as an independent simple engine, with its own complete system of valves, and with the receiver acting as a secondary boiler. While the Woolf type permits a simpler construction, the difficulties attending a proper steam distribution, especially under varying conditions, have prevented a general adoption. In fact, its occurrence is so rare as to be practically unknown. To better appreciate the difference in the action of the steam in the two types, the following ideal comparative diagrams are given, with the distinguishing features in each noted (Figs. 149 and 150).

* Presented at the San Francisco meeting of the American Society of Mechanical Engineers.

With the aid of these cards, let us trace the objections to each system as a preliminary to the reasoning which led to the correction of the faults in the new type. In the Woolf engine the resultant enormous compression in the high-pressure cylinder with small clearance and early low pressure cut-off, or the great loss through clearance with a moderate compression, and the inability of any construction to maintain its efficiency under even ordinary changes of conditions, has effectually prevented the development of this type.

It has been perfectly possible to design a special form of Woolf compound which would be highly economical; but the design invariably possessed no elasticity in its application, and rapidly lost in its efficiency with a change of load or pressure.

The receiver type, however, is much more flexible in this respect and will allow more variation in construction and conditions of operation, without unduly increasing the rate of steam consumption, until the range of conditions becomes considerably greater. In all engines of this class, however, free expansion into the receiver, as illustrated in the ideal card, means proportional loss in economy. The receiver is really a clearance space, causing a loss greater or less according to its capacity and to the rise in pressure during the exhaust of the high-pressure cylinder. The argument that the energy lost in this expansion is absorbed by the remaining steam in the receiver is in accordance with the conservation of energy, but it is wasted energy, as it is not afterward returned to the engine. Under constant conditions, the same amount of steam which leaves the high-pressure cylinder must enter the low-pressure cylinder; and if the initial pressure of the latter be less than the terminal of the former, there is a difference of potential energy in these two conditions that no subsequent manipulation can recover.

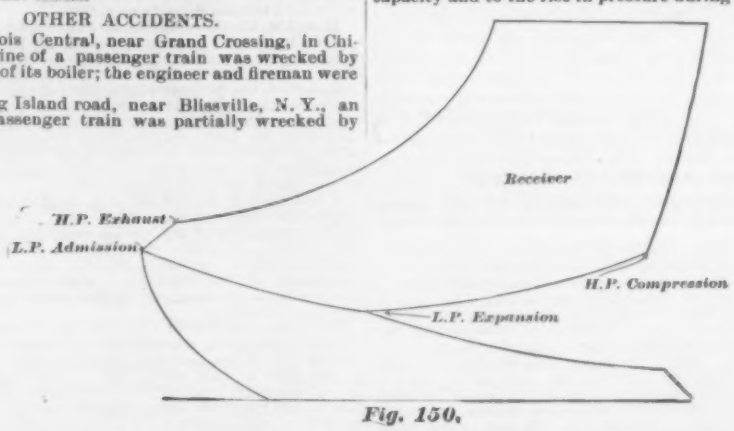


Fig. 150.

Another source of loss in the receiver is the change in pressure and temperature to which it is subjected.

There can be no doubt that the laws relating to condensation and retarded re-evaporation hold true with the receiver, as with the cylinders. An increase in the size of the receiver increases the area of condensation and radiation, so that, all other things being equal, the increasing consumption of steam must keep pace with the capacity of the receiver.

Recent practice seems to be in favor of the smaller receiver, so that the steam distribution more nearly approximates that of the Woolf type; but the margin of conditions under which the engine can be operated economically is reduced exactly in proportion as the high economy incident to the Woolf engine is approached in this manner.

For a considerable over-load or under-load, the engine must be re-designed with respect to its steam distribution, or operated at a much lower efficiency, as is the law in a greater degree with the Woolf engine.

Inasmuch as it is the exceptional case where an engine is exactly suited to its work the average commercial performance is far from what can be obtained under test conditions.

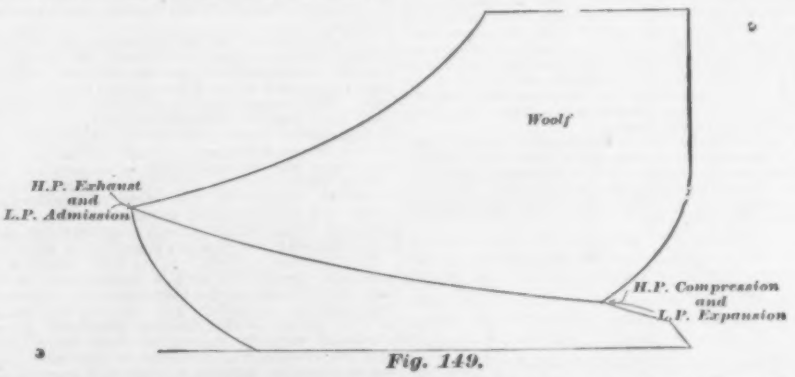


Fig. 149.

The evil is more marked with light than heavy loads, and in work demanding extreme variations of power the high pressure cylinder is frequently forced to supply all the power and in addition drag along with it the low pressure piston, whose cylinder indicates negative work.

The indicator card (fig. 151) will illustrate this action perfectly and show that the proper division of temperature between the cylinders was possible only with the load for which the engine was intended.

As the whole range of temperature is covered in the high-pressure cylinder, the economy of the engine approaches that of a simple engine; but the net result is a considerable loss over what could be realized from the single cylinder alone, on account of the additional friction and enormous internal negative work of the low-pressure cylinder.

It has been but a short time since this question demanded consideration. Heretofore compound engines have been built for particular kinds of work where load and steam pressure were maintained nearly uniform; while any considerable increase in the original plant was quickly followed by the installation of an engine of suitable power. Since the rapid development of

electrical industries, a demand has originated for an engine of high and comparatively constant economy under the widely different conditions incident to this service; and it was particularly true in the case of electric railways, where the average horse power might correspond with the engine's rating, yet the actual working load would range far above or below this amount the greater part of the time. So great is this commercial loss with high-class compounds under such conditions, that it is still an open question with engineers whether simple engines in a subdivided form and maintained at a uniform load, are not more economical than centralized power, in the form of a compound, subjected to such varying loads.

The objections which have been considered are general in their nature, and applicable to all compounds in degree according to the type they represent. They are wholly independent of the speed or any other distinguishing feature that characterizes a particular style of engine.

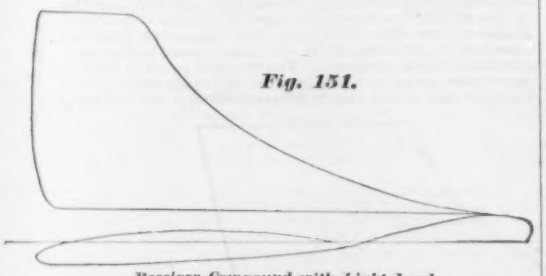


Fig. 151.

Receiver Compound with Light Load

From the limitations thus described it will appear that the problem to be solved was reduced to the following:

Given an extreme range of conditions as to load or steam pressure, either or both, to fluctuate together or apart, violently or with easy gradations, to construct an engine whose economical performance should be as good as though the engine were specially designed for a momentary condition—the adjustment to be complete and automatic. Technically, this may be reduced to read: Design an engine compounded, whose individual cylinders shall be subjected to a constant range of temperature, under constant limiting pressures, with different loads, and whose governor shall automatically readjust the division of the total range of temperature with different pressures at either extreme of the cycle, and at the same time regulate the speed.

It may be readily believed that the fulfillment of this self-imposed contract was not an easy matter, so that the successive steps in their order of development may be interesting.

At first, expansion curves alone were considered and

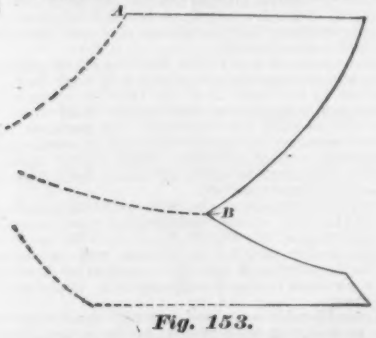


Fig. 153.

discussed, with, however, no idea of the development of a distinct type of engine. In fact, quite contrary to the usual plan, the form of the engine was not determined until after the steam distribution was developed. The objections to the older forms were recognized; but for a long time no means were discovered to correct them. Either seemed to require such a complicated system of valve gear to obtain a proper distribution of steam, that it became very doubtful if a commercially better article than already existed could be worked out. The Woolf engine seemed unsuitable, for reasons already explained, although long consideration was given it. In the receiver engine, the little line which marks the fall of pressure between the cylinders was a stumbling block that obstinately intruded itself.

After several months of investigation, the discovery was made of the peculiar value of a receiver of predetermined volume which should act as a clearance chamber for compression in the high pressure cylinder. This can better be understood by reference to the fragmentary indicator card (fig. 153).

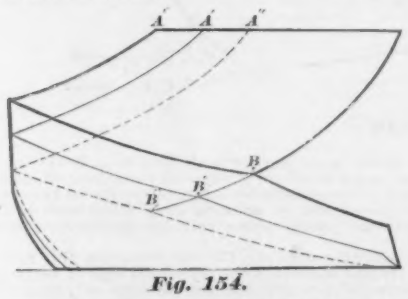


Fig. 154.

It may be stated in general that an engine may be designed that will cut off at any convenient point (*A*) in the high-pressure cylinder, and through process of expans on reach the point (*B*), the cut off in the low-pressure cylinder, from which point the steam can be compressed to boiler pressure in the high-pressure cylinder, and expanded to a proper terminal in the low-pressure. We have so many unknown quantities, that we are at liberty to vary any one or several at will, without altering the results. For instance, if the clearance which allows a proper compression in the high-pressure cylinder be changed, we are at liberty to change the point of cut-off in the low-pressure cylinder so that the same degree of

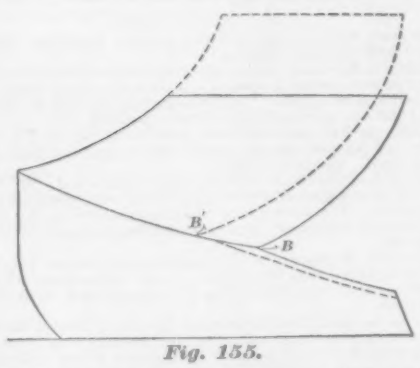


Fig. 155.

compression is maintained. If, however, it be stipulated that the cut-off in each cylinder shall be equal, then the high-pressure clearance can no longer be altered, but must be a certain definite quantity.

If, again, the distribution be effected by a single valve, driven by a shaft governor, the cut-off in each cylinder must be equally variable, and the point (*B*) will follow a path according to the law of its production, and dependent on the proportionate parts of the engine.

The particular discovery that proved so valuable was, that under these last conditions, the point (*B*) (Fig. 154) followed the path practically of a hyperbola, and that with a proportional clearance equal to the ratio of the cylinders, this path might be made to coincide with the hyperbola of the compression curve.

A variation in the cut off of the high-pressure cylinder varies the point (*B*) to or from the atmospheric line, while a variation of the low-pressure cut-off changes its position in a direction parallel to this line. A simultaneous variation of both cut-offs makes the resultant movement of the point upon which so much depends, and which is determined by the clearance of the high-pressure cylinder.

With an independent valve for each cylinder, it would be easy with any convenient clearance to so vary the cut-off in the low-pressure cylinder, that the variation of pressure at this point, due to varying cut-offs in the high-pressure cylinder, should cause the point (*B*) to fall on any high-pressure compression curve that should be determined on; but with a single eccentric valve-gear these points of cut-off must always be equal and similarly variable, so that the discovery was really essential to the simplicity that was attained.

It seems a lucky chance, although it is really part of the law which controls the movement of this point, that, as the pressure changes and the high-pressure compression varies, the point (*B*) leaves the path to which it has so closely adhered, and adopts a new one—

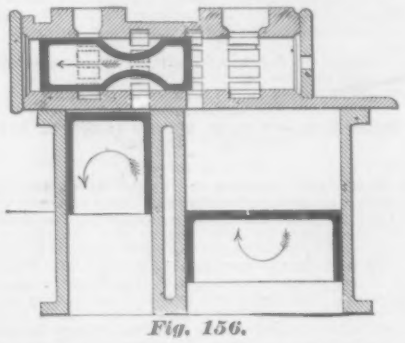


Fig. 156.

still a hyperbola—which cuts the steam line at the same point of admission (fig. 155).

So far, all considerations have been with the seemingly eccentric behavior of the point (*B*), and the reduction of its locus to a law which has been turned to important practical use, while the results have been obtained with a form of valve which has but one lip between the two cylinders.

In the course of the investigations the proper amount of high-pressure clearance to suit the various points of cut-off was graphically determined, and a rather curious result obtained at the limiting full stroke and zero cut-offs. With steam carried full stroke in both cylinders, the high pressure clearance must obviously be zero to compress to boiler pressure in the high pressure cylinder; while with zero cut-offs in both cylinders the clearance may be anything to accomplish this result. These unsatisfactory and indeterminate volumes were, however, caused by the error of considering conditions that are impossible in practice. Any intermediate position of the cut-off gives a positive value to the clearance chamber, varying but slightly (fig. 156).

The average cut-off of one-half declares that the amount should be such a percentage of the high-pressure cylinder as the high-pressure cylinder is of the low-pressure cylinder; and at cut-offs on each side of this point to the limiting practical positions, the clearance volume departs so little from this amount that the error can be corrected by the very slight shifting of the valve through a coincident varying angularity of the eccentric rod. That is, under shorter cut-offs a little greater clearance is required, and on longer cut-offs a trifle less is necessary; and to balance this error the angularity of the eccentric rod can be made to introduce a counteracting error, by which the high-pressure

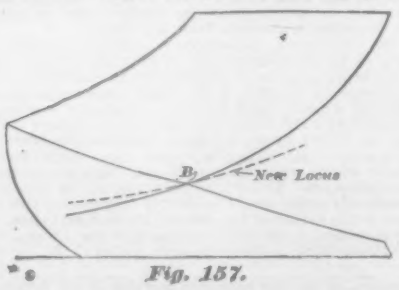


Fig. 157.

cut-off changes more rapidly than that of the low-pressure. In practice, the error measured in pounds of steam consumed is so slight as to be unnoticeable; and in fact, for other reasons which shall appear, these varying dependent cut-offs are caused to depart from one another in exactly the opposite direction.

Although the compression in the high pressure clearance space to initial pressure is theoretically correct and advisable, yet certain narrow departures from this degree may be allowed without materially altering the economy, if by means of this a much greater gain can be made at some other point in the steam distribution.

If the distribution of steam were entirely dependent on the truth of the point (B) to the path in which we have constrained it to move, then the line (D), (fig. 152), would in reality fall slightly with shorter cut-offs

Fig. 158.

and rise again with the longer ones. Fortunately we have still the low-pressure compression with which to make a fit finish to the usually tiresome work of correction.

Under the influence of a single-valve variable cut-off, the low pressure compression rises from a constant pressure, but with a period varying almost as rapidly as the cut-off.

The benefit in this case of such a peculiarity is in early exhaust closure with the lighter loads to prevent undue radiation to the condenser, and to raise the temperature of the cylinder so that there will be no surface condensation when the steam port reopens.

In the later cut-offs, the water of condensation is re-evaporated to a great extent before the point (*B*) is reached, and a considerable portion of the original steam is recovered for compression in the high-pressure cylinder; but, in the earlier cut-offs, re-evaporation does not begin until the high-pressure cylinder is shut off from the low-pressure, so that it is important there shall be little or no secondary initial condensation.

The amount of heat radiated during exhaust is de-

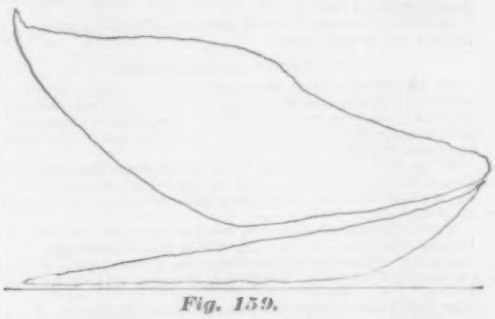


Fig. 159.

pendent somewhat on the speed of the engine, and nearly proportional to the time the exhaust port is uncovered; so that an early compression, with a short cut-off, is valuable in reducing the total radiation to the condenser, thereby making the percentage of loss more nearly constant, as well as reheating the cylinder to prevent initial condensation.

To the very natural question as to the reason for neglecting the radiation in the longer cut-offs, the answer is that the gain in power sinks the percentage of loss from this cause to such a small amount that the engine really effects a net gain by ignoring that factor.

Moreover, the variable low-pressure compression acts as a corrective influence over the point (*B*), which if left to follow the course subject to the equally variable cut-offs in the two cylinders alone, would too rapidly lower the line (*D*), (fig. 152).

The variable low-pressure compression would, however, overdo the work we have indicated, were the angularity of eccentric rod not interposed as an anti-

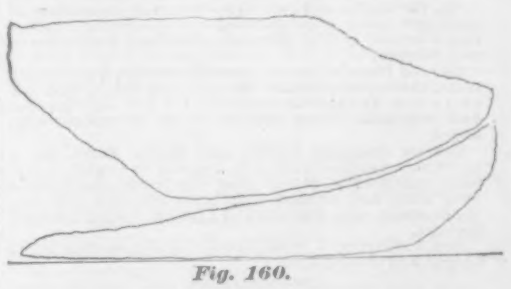


Fig. 160.

corrective measure, and the progression of the low-pressure compression retarded, while the point (*B*), thrown slightly from the path to which we have assigned it, varies the high-pressure compression a little on each side of the constant curve of its true path (fig. 157).

The diagrams (figs. 158, 159, 160), reproduced from actual cards, and representing light, medium and full loads, respectively, illustrate the practically constant division of temperature between the cylinders, and are a graphic proof of the successful application of the new method.

The practical results in fuel consumption are represented by the tabulated water rates under different conditions, both condensing and non-condensing.

WATER RATES, BY TEST, UNDER VARYING LOADS.

Horse-power.	210	170	140	115	100	80	50
Non-condensing.....	22.6	21.9	22.2	22.2	22.4	24.6	28.8
Condensing.....	18.4	18.1	18.2	18.2	18.3	18.3	20.4

It would be insufficient to dismiss with so brief a mention the subject of radiation to the condenser, and the influence of the variable low-pressure compression as a partial correction for this loss and a factor in the development of the constant economy under varying conditions that has been accomplished.

A properly variable low-pressure compression may be regarded only secondary in importance to the practically constant high-pressure compression; and as this design has undoubtedly originated the principle of overcoming by a proper compression the otherwise great waste of a large high-pressure clearance chamber, so it is also believed to be the first to practically acknowledge and control the heat of radiation during low-pressure exhaust by a properly variable low-pressure compression.

After the detailed explanations it will be interesting to note, as an evidence of the remarkable flexibility of the practical engine, that the valve adjustment may be set so far from true that the shape of the indicator cards are considerably altered without materially affecting the economy of the engine.

The explanation is that the line (*D*) does not depart from its position unless the valve error be excessive, because the error introduced by such readjustment on one cylinder is in a measure corrected by a balancing error on the other cylinder. It must be understood that the whole economical result of the engine is directly dependent on the path of the point (*B*); and that, in the finished locus of the point, every part of the engine has an influence, greater or less.

As a type the engine must be considered as a union of the two older ones, partaking of the nature of each, yet with the objections to either eliminated and the good qualities of both retained. The receiver is so disguised as to be scarcely recognized; and, as a clearance cavity to the high-pressure cylinder, absorbs all of the compression instead of only a part. On the other hand, the single dividing lip of the valve reduces its functions to resemble those of the Woolf type.

Ordinary possible derangements have little or no influence in changing the division of temperature and the consequent economy of the engine; yet a radical change in dimensions, such as the shape of the valve which contains the clearance space or in the proportion of the cylinders, would necessitate an entire new design, in which every other part should reconform to the single departure.

Alabama Railroad Commissioners' Report.

The Railroad Commissioners of Alabama, Henry R. Shorter, Levi W. Lawler and Wiley C. Tunstall, have just issued the eleventh annual report of the board, the statistics being for the year ending June 30 last, and the date of the report Feb. 1. The length of new railroad built during the year was 88½ miles, and the total length of road in the State at the end of the year appears to have been 3,244 miles. Roads operating 52 miles are not required to report, and the length of side tracks in the State is 502¼ miles. To these figures the Commissioners add 10 miles of second track, and make 3,809 miles of track in the State, which, however, excludes 115 miles of "dummy" lines; but the Commissioners have no official relations with the dummy roads.

The Commissioners complain that the railroads do not send in their reports promptly. They also recommend a change in the date for filing their report with the Governor, but the Legislature has not yet approved the bill on this subject which they presented to it. About half of the report is taken up with complaints of towns about insufficient station facilities.

The Memphis & Charleston bridge over the Tennessee River at Florence is the subject of a long paragraph, and it appears that many written and verbal complaints have been made to the commissioners about it. They "have considered the matter with anxiety," but their action does not seem to amount to much. The railroad company asserts that the bridge is safe for light loads, but nothing is said as to what the actual maximum every day load is. We believe the newspapers have reported two or three bad derailments on the bridge (or the approach), but we have seen no specific evidence as to whether the accidents were due to the weakness of the bridge, and the Commissioners say nothing about them.

The statistics of mileage of road, tons of freight carried, number of cars and engines, number of employés, train mileage and accidents are tabulated for the whole state, and the figures for Alabama are separated from those pertaining to other portions of the roads reporting as fully as it is possible to do so, but the tables are not footed up.

Eight passengers, 84 employés and 65 other persons were killed in the state during the year, and 108 passengers, 906 employés and 1,112 other persons injured.

The reports of the companies seem to be printed in full and they occupy 440 pages.

The Railroad Side of the Matto Grosso Revolt.

The revolt of the state of Matto Grosso at first seemed insignificant, and the subjection of a territory whose total population does not exceed 200,000 would not appear to require much military strength or genius. The situation, however, is complicated by the attitude of her neighbors on account of the fact that Matto Grosso is likely to become the distributing centre for an immense area of central South America, embracing the entire central-southwestern portion of Brazil, and the great plain of Mojos in Bolivia, which will have an important influence upon the commerce of Paraguay and to some extent upon that of Argentine. The future commercial greatness of Bolivia is so apparent that there is a race between the surrounding nations to divert to themselves this prospective trade. To this end Argentine has been pushing forward the Central Northern railroad toward the mining centres of Bolivia, and has made several efforts to ascertain the feasibility of a route parallel with the Rio Pilcomayo through the Gran Chaco. Paraguay also has hopes of penetrating Bolivia, and is now surveying a route intended to cross the mountains to La Paz. Matto Grosso, however, occupies a superior position, commanding the watersheds of the Amazon and the Paraguay, and being accessible by steamers from both directions.

Brazil's special problem, into which Matto Grosso enters prominently, is to secure rail communication from the east coast through this territory, with two objects in view. One is to obtain easy communication through her own boundaries to the Rio Paraguay, thus enabling her to mobilize troops along her western frontier, and to menace her historic enemies, Argentine and Paraguay, by means of gunboats which she could construct in Matto Grosso and navigate down the Paraguay. The other is to control the commerce of the Plain of Mojos, which would yield in time an immense revenue to her railroads, and largely benefit her merchants through whose hands this commerce would pass. It will be remembered that it was for the sake of this same commerce that Colonel Church attempted to build the Madeira & Mamoré Railway, around the falls of the Madeira. It is stated that Argentine is giving the revolutionists such support as she can without incurring diplomatic complications.

Firebox Steel.

BY P. KREUZPOINTNER.

In a recent editorial of the *Railroad Gazette* the difficulty of detecting laminations was dwelt upon. With steel plates this is not such a difficult matter. The very cause of laminations in steel plates tends to their more easy detection than laminations in iron plates. In iron plates the laminations are caused by the cinder becoming lodged between the surfaces of the layers of iron, which go to make up the "pile," thus preventing the proper welding together of the surfaces in larger or smaller areas, as the case may be. In steel there is no slag and the laminations are caused by the fluid steel absorbing gases, which on the steel cooling in the ingot mold does not entirely escape.

However, there are steel plates made sometimes by the process of "piling." That is, ordinary steel scrap, the cuttings from steel and iron plates, or the former alone, are laid upon each other until a square "pile" is formed. This "pile" is put into a heating furnace and when at a welding heat is rolled out into plates and sheets. The resulting plates are tested for laminations in the same manner as iron plates. Though made of steel, the plates manufactured this way are not steel plates, though perhaps they may be sold some time under that name. A steel plate proper is one that has been rolled from a cast ingot.

If steel plates are examined for laminations at all, it is done in a manner different from that by which iron plates are examined for this defect. As a rule, however, this is not done. To examine every plate in a steel mill in the manner iron plates are examined would be a physical impossibility. If laminations are suspected, a piece is cut off on one of the sides or ends of the plate to be examined, the edge planed and filed smooth, polished with emery cloth and etched. This, however, requires time and care which is not always at the disposal of the mill-man or the investigator.

A shorter way, and one quite efficient, to test a steel sheet for laminations, is the nicking test. The nicking test should be called the inspector's best friend and helpmate. The seeker after truth can get more information out of a nicking tests than many think of.

To test a piece of steel plate for laminations, the piece is clamped in the vise and nicked on one of the surfaces about $\frac{1}{32}$ deep with a sharp cold chisel. The portion above the vise is then bent over with a hand hammer until either the piece breaks at the nick or bends double. If the steel is laminated, one or more openings will be perceived, gaping apart more or less, along the fractured surfaces. The length of these openings varies from one eight to half an inch. The depth is also variable. Sometimes one single laminations runs through the centre of the piece, while the metal on either side is entirely homogeneous. Sometimes also we find the whole fracture opening out like the leaves of a book. This last description is seldom met with any more, owing to increased skill and knowledge of the steel makers. But if it is met with, such a plate should be returned without hesitancy. No magnifying glass is needed when examining a nicking test for laminations. The laminations which cannot be seen at once with the unaided eye need not bother the investigators. Often the fractured surfaces present a compact appearance, and the structure gives the impression as if composed of fine scales shining like silk.

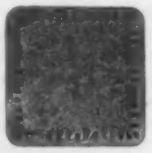
This is not indicative of laminations. On the contrary such steel is desirable. Only in very rare cases do laminations in steel plates assume the proportions and nature of laminations found in iron plates.

As to the origin of laminations in steel plates it may be interesting to say a few words. Many metals have a tendency to absorb gases when in a liquid state. In some cases the chemically purer metals more so than others. During the period of cooling down from a liquid to a solid state, these gases are given off again largely by the metal. Silver, for instance, that is silver, without an addition of copper, absorbs considerable of the oxygen of the atmosphere. If the crucible in which the silver was melted is set aside without pouring out the silver, but letting it solidify in the crucible, then at the moment of semi-fluidity the absorbed gas will escape amid considerable ebullition of the silver, the agitation caused thereby sometimes throwing out portions of the silver. In steel and cast iron, however, not all of the gases secluded in the metal escapes before final solidification. What remains causes the vexatious "blowholes" in steel and iron castings. In steel, which is subsequently hammered or rolled into sheets, plates, blooms or rods, these blowholes are compressed, flattened out, and thus become laminations.

The more blowholes in the steel ingot, the more laminations in the finished article. Likewise the larger the blowholes the larger the laminations. Under unfavorable circumstances an ingot may be fairly riddled or honeycombed with blowholes. How to get rid of the gases and to produce steel free from blowholes and laminations is the steelmaker's constant, anxious endeavor in daytime and his dream at nights.

While the steel cools in the mold the occluded gases try to escape, and if it were possible to keep the steel in the mold in a liquid state long enough, then, generally speaking, all the gases would escape, and blowholes would be unknown. As it is, the gases rise to the surface and toward the side of the ingot in trying to escape, while the steel is still fluid enough to do so. This is the reason that the top and surfaces of an ingot are more likely to be found honey-combed than the bottom and centre. This is also the reason why it is desirable to have as much of the top of an ingot cut away as is possible to secure solid product. The objection to this, from the steelmaker's point, is, that the more he cuts off the more scrap he has to handle and remelt, and the more ingots he has to have in the first place to get a given quantity of product. When a metal is poured from the top, that is, poured into the opening to fill the mold, which is the only outlet for the gases, then the chances for honeycombing are increased. For this reason large steel castings and steel ingots are now "bottom poured," that is, a number of molds are set in a circle on the bottom of the casting pit.

A channel of firebrick runs from the bottom of the molds toward the centre where all the channels converge, and are connected with a cast iron funnel through which the metal is poured, which then fills the ingot molds from the bottom up through the channels radiating from the "riser." Thus the gases are given all possible chances to escape before the metal solidifies, since there is no obstruction, as in top pouring. This method has been found very beneficial. Of course in practical steel making the methods vary, and "top pouring" is still met with. However the steelmaker may be relied on that he has good reason for doing so, and whatever his method, his one object is always to get rid of blowholes and to produce a "solid" ingot. The sketch shows



a transverse section of a steel ingot with a moderate number of blowholes. The regularity of position of the blowholes is due to the rapid cooling of the outer crust of the metal when coming in contact with the inner walls of the ingot molds. In the central and hotter portion of the ingot gas is still evolved. The hard crust, however, prevents its escape to the outside and a little gas bubble hangs there, like an air bubble in a glass of water adheres to the side of the glass. As the cooling proceeds more gas is evolved and finds its way to the little bubble already formed, enlarging it toward the middle of the ingot, thus giving the blowhole a pear shaped form.

If we inquire into the probable effects of laminations on the wear and tear of firebox steel it must be admitted that, while they do not tend to produce sudden and dangerous failures, resulting in explosion, yet they may become very annoying and expensive at times. It goes without saying that a solid, thoroughly homogeneous metal is stronger, can "stand up" better, is better able to resist the action of the manifold forces which tend to destroy a firebox, than a metal the continuity of structure of which is more or less destroyed by flaws of greater less extent.

It is conceivable that laminated steel would not offer as much resistance to crushing, if the force were applied in the direction of the laminations, than steel not so laminated, even if the tensile strength of both pieces were the same. If this be true then we may expect to see a firebox, built of laminated material, "settle" and bulge more easily than one built of homogeneous steel The laminations prevent the close and intimate interlocking of the individual particles, as it were, and thus are deprived of the support of their neighbors. wherever a lamination happens to be. Supposing a load to be placed on the edge of a laminated sheet, it would undoubtedly take a smaller force to compress such a sheet edgewise, due to the already existing separations, in part, of the metal, than it would take to compress a solid, homogeneous plate.

(*Continued on page 395.*)

RAILROAD GAZETTE

ESTABLISHED IN APRIL, 1856.
Published Every Friday.
At 73 Broadway, New York.
The subscription price is $4.20 a year in North America, and $6.08 in foreign countries.

EDITORIAL ANNOUNCEMENTS.

Contributions.—*Subscribers and others will materially assist us in making our news accurate and complete if they will send us early information of events which take place under their observation, such as changes in railroad officers, organizations and changes of companies in their management, particulars as to the business of the letting, progress and completion of contracts for new works or important improvements of old ones, experiments in the construction of roads and machinery and railroads, and suggestions as to its improvement. Discussions of subjects pertaining to* ALL DEPARTMENTS *of railroad business by men practically acquainted with them are especially desired. Officers will oblige us by forwarding early copies of notices of meetings, elections, appointments, and especially annual reports, some notice of all of which will be published.*

Advertisements.—*We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay,* EXCEPT IN THE ADVERTISING COLUMNS. *We give in our editorial columns* OUR OWN *opinions, and those only, and in our news columns present only such matter as we consider interesting, and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially, either for money or in consideration of advertising patronage.*

A contemporary has said: "As for the holding power test, the Westinghouse brake has evidently been designed to let a little more air leak into the brake cylinder than leaks out of it while the brakes are on, so that, if anything, the brake pressure shall rise during a prolonged service application and the average be maintained in spite of a few leaky pistons." Truly a little knowledge of air brakes leads to strange conclusions. The discovery that the triple valves in question were designed to leak was made while searching for the cause of the slow increase of pressure in the brake cylinders during a long time application to show what the action of the brakes would be on a long grade. A glance at the conditions existing at the time of the test will show at once that there was no proof that the triples leaked, as a leak in the train pipe would have caused identically the same apparent leakage of triples that has led to the remark quoted above. In fact, from other tests made at the same time it was shown that the triples were practically free from leakage, and the continuous, uniform reduction of the train pipe pressure is sufficient evidence that the train pipe was not free from leaks. Had the train pipe been absolutely free from leaks, any material reduction of auxiliary reservoir pressure by leakage of air into the cylinder would have caused the brake to release. To design a triple to *leak to suit* is more of a problem than to design one to keep perfectly tight, as there is a margin to work on when the triples are to be kept tight. That is clear, for when a triple is once made tight, by the valve covering the port, an increase in the covering does not change the condition; it is still tight. But if a valve leaks, it may leak more or it may leak less, with a difference quite sufficient to defeat the end sought. Our contemporary may be sure that triples are not designed to leak; it is quite trouble enough to keep them tight.

In our issue of April 8 we gave an abstract from advance sheets of the report of the Boston Rapid Transit Commission. Recently we have received the report in full and have read it with considerable care and much interest. It is an admirable piece of work. The Commission included Mr. William Jackson, City Engineer, and appointed Mr. George S. Rice its Chief Engineer. It then called in as Consulting Engineers Messrs. Theodore Cooper, A. Fteley and F. P. Stearns. It is impossible to ascertain from the pages of the report just what is due to the individuals concerned except in so far as may be judged from the reports of the engineers and of two of the Commissioners, which appear in the appendices. The whole document fills about 300 octavo pages and has, besides, many sheets of drawings; and it is very thorough and scientific. The peculiar merit of the plan proposed is the intelligent utilization of existing railroads. The Commissioners and the engineers have not treated their scheme as independent of or hostile to the railroads now serving the city, but have undertaken to supplement these latter, and to make a harmonious combination. They begin their suggestions with a recommendation to regulate the street traffic in the crowded districts. They recommend widening and improving certain streets and cutting certain new ones. They recommend two union passenger stations to serve the existing railroads as well as the new circuit: and they recommend a radical separation of the freight and passenger traffic of the present railroads at their Boston termini. The new railroad that they recommend is 13¼ miles of double track. Part of this is an inner circuit, inclosing the most congested district, and uniting the termini of the railroads now serving the suburbs. Part of this 13¼ miles of new railroad goes to make an incomplete outer circle by uniting various existing lines. These existing lines will thus serve as radial feeders to the inner circuit, and trains may be run around the inner circuit; others may be run in from one radial line, around the inner circuit and out over the same line; or, finally, trains may be run in by one line, partly around the circuit and out by another line. This is but a brief outline of a very detailed and well digested plan, but it will serve to indicate its comprehensiveness. The first great characteristic of it is that it takes into consideration all the conditions, and the next is that it proposes to make use of such means of transportation as Boston now has.

Good and Bad Signal Lights.

The imperfections of colored signal lamps form the subject of a communication which we have received from Mr. Arthur H. Johnson, Engineer of Signals on the New York, Lake Erie & Western. Mr. Johnson's chief argument is contained in a paper by Dr. B. Joy Jeffries, of Boston, which he incloses, but which is too long for us to print. This paper, written several years ago, details some of the Doctor's experiments with colored glass for signal lights. Dr. Jeffries' experiments are always interesting, as he has been a most thoroughgoing investigator of that subject in connection with color-blindness and other defects of vision. In this pamphlet he tells how the blue in the blue-green and the yellow in the yellow-green glasses, so commonly used, enable most color-blind persons to distinguish such lights from red (the blue and the yellow rays being as distinctive to them as to normal-eyed persons), and thereby to deceive ignorant examiners who try to test them for defective vision.

The desirability of pure green and pure red for signal lamps has recently been pointed out in these columns. Enginemen ought to be able to distinguish a color-signal by its color, not by its apparent degree of smokiness (as they often do with blue-green if they are color blind); and if we are to use colors at all, the code should be made up, as it purports to be, of the most distinctive colors available, which are pure red and pure green. This purity of color is highly desirable, aside from any question of using a third color. As to increasing the power or intensity of lights, the importance of which is referred to by Mr. Johnson, Dr. Jeffries, in this paper, only points out the need, saying nothing about the means, except to state that he had induced the New England Glass Works to make lenses of the most scientific shape and of exactly the right color.

Mr. Johnson emphasizes Dr. Jeffries' assertion that all attempts to show the *shape* of a light are ridiculous; but in this argument the Doctor had reference to triangular, square and star-shaped holes in an opaque screen, illuminated by a single lamp, and his statements cannot be regarded as an answer to the claims made for the illuminated blades now used. Our correspondent apparently intends it for such, but it is evident without argument that the shape of a light can be shown readily enough up to working distances if only it be made large enough; and this question of size, and the consequent expense, is really the vital point. The Boston & Albany has for several years used two white lights, placed in a horizontal line, for a stop signal, and is constantly running fast trains under that system. That is in the main idea a shape signal. If the 30 inches, more or less, between the two lights were filled by two or three other lights the idea of shape might be more readily apprehended by critics, but it will hardly be claimed that the distinction from a perpendicular bar of light would be any *less* effectual.

Of course, it is possible to get far enough away, even from a locomotive head-light, to make its shape wholly indistinct, but that simply brings up again the question how far a signal ought to be discernible, which question we still insist is generally treated as more important than it really is. When a superintendent comes to realize how often runners have 10-second, 30-second, and even 60-second fits of absent-mindness he begins to see the importance of having *all* signals arranged on the principle that they will not be heeded until the train gets within a few hundred feet of them. The flagging rules for brakemen very fully recognize this principle already, but when a fixed signal is erected all interested seem to be at once possessed with the notion that the main purpose of that signal is to give warning to enginemen a mile away, forgetting the fact that the runner wants the signal largely, in many cases chiefly, for the aid it will give him in times of fog, when no signal can be read more than a few hundred feet away. The real reason for giving enginemen a long distance in which to see a signal and to act on the indication it gives is, in many cases (though people holding this view do not always analyze their own thoughts on the subject), to give them time to see it in spite of habits of reading, talking with the fireman, looking at the scenery, and so on. But if a man is given 10 seconds in which to perform a duty that he ought to perform in one second, it often results in his taking 20 seconds, and the scheme thus defeats its own object. Assume for a moment that all trains can be stopped in say 1,200 ft. This is not an unfair limit as a basis of argument. At some signals *all* the time, and at all signals *some* of the time, this is the maximum distance at which the signal can be seen (where trains require this distance for pulling up, and fog obscures the signal short of 1,200 ft., we assume that distant signals are used). This being so, why waste effort in making signals visible 2,000, 3,000 or 6,000 ft. away?

We state the foregoing considerations because the demand for powerful lamps is made by so many persons on irrational grounds. At the same time we recognize the importance of good lamps even for short distances. Whether a light is to be seen 300 or 3,000 ft. away it should be of good size, and the attendant should always adjust the wick so as to make the light of the same intensity every night; the glass should always be clean and the bull's eye should always throw the rays in precisely the same direction. Mr. Johnson gave some valuable hints on this phase of the subject in the *Railroad Gazette* of Oct. 24, 1890. This matter of fixing the lamps firmly to the posts, of making them in a substantial manner, and focusing the flame with precision needs attention on a good many roads. The only argument that we know of, suitable to present to railroad officers who are still content to use poorly constructed lamps cared for by slovenly inspectors, is to take them on a night visit to a road using good lamps. Salesmen who have failed of success in direct missionary work might try this.

The Party Rate Case.

The Supreme Court has decided that the "party rates" granted by the Baltimore & Ohio Railroad for parties of ten or more traveling on one ticket are not a violation of the provision of the Interstate Commerce law which forbids unjust discrimination.

The complaint was made originally by the Pittsburgh, Cincinnati & St. Louis Company, before the Interstate Commerce Commission, which declared such rates to be an unjust discrimination within the meaning of the law, and ordered the practice to be discontinued. The Baltimore & Ohio refused to obey this order, whereupon the Commission applied to the United States Circuit Court for the Southern District of Ohio for an injunction to restrain it from such violation of its order. This court granted the injunction, whereupon the company appealed to the Supreme Court, alleging that the finding of the Commission was contrary to the facts, and that these facts showed that party tickets such as were issued were not an unjust discrimination.

The Commission seems to have based its decision on a very narrow interpretation of the law, which, after its general prohibition of unjust discrimination, specifies that certain kinds of transportation at reduced rates shall not be prohibited, among which party rates are not mentioned. The Commission seems to have regarded that all transportation at reduced rates not specifically mentioned here is prohibited. But the Supreme Court says that to constitute an unjust discrimination "the carrier must charge or receive directly from one person a greater or less compensation than from another, or must accomplish the same thing indirectly by means of a special rate, rebate, or other device; but in either case, it must be for a like and contemporaneous service in the transportation of a like kind of traffic, under substantially similar circumstances and conditions;" and it quotes with approval from the dissenting opinion of Judge Jackson in the court below, who said that in passenger traffic "there must be found to exist substantial identity of situation and of service,

accompanied by irregularity and partiality resulting in undue advantage to one, or undue disadvantage to the other, in order to constitute unjust discrimination." Here seems to us to be the heart of the matter. The very first thing to ascertain when discrimination is shown is, who suffers by it? If no one, then it is difficult to see how it can be called unjust.

But they are in error who suppose that this will permit infinite discriminations with little reason, or that the "wholesale principle" may be made under this decision to make great differences in rates for shipments of different quantities. In fact, the "wholesale principle" has a narrow field for application in railroad rates; that is, the reasons which cause goods to be sold in very large quantities for much less than retail prices do not hold good for most of the circumstances of railroad traffic. If a lower rate should be given for two car-loads of freight than for one car-load it might utterly destroy the business of the shipper who seldom or never requires more than one car load at a time, and that would be a discrimination of the most unjust kind. The railroads should take the utmost care to make no discriminations of this kind, and the Interstate Commission to prohibit them when discovered; and, in so doing, it will no doubt receive the support of the same court which has just decided against it in the party rate case.

Doubtless there are cases where it is difficult to decide how great a difference may be allowed when a lower rate is justified by some manifest difference in the expenses of the carrier; and it will not be a hardship if the railroads are required to show that that for which a reduction of rates is granted is an advantage to them at least as great as the amount of the reduction, where any shipper may be put at disadvantage by such difference. It is better that no differences be granted for slight differences in the carrier's expenses, than that one shipper should suffer by another's advantage in rates.

The objection of some of the railroad companies to party rates is that they may be made to apply to other travel. But if any railroad should permit an isolated passenger to travel on such a ticket that would be a violation of the law, however legitimate the original issue of the ticket. Whether such tickets make it easier to practice secret discriminations is a practical question which the courts are not called upon to consider, at least until they have proof that they are so used.

Roller Bearings.

The subject of roller bearings for car journals came up at the April meeting of the New York Railroad Club, and the statement was made that such bearings did not reduce friction at high speeds. This is probably not true; at least, no one knows that such is the case, because no tests have been made at high speeds with roller bearings to determine whether the friction is reduced or not, but it is highly probable that the friction is reduced considerably. However, it should not be understood from this that roller bearings are of any great practical value at high speeds, for the reason that at high speeds journal friction is not a large percentage of the total resistance. The one place where roller bearings are of great value is when a train is being started slowly from a standstill. Then the journal friction is a large percentage of the total resistance of the train. This is why roller bearings are so useful for horse cars. Horses start cars slowly, and a saving in the resistance of the cars at starting reduces enormously the wear and tear of the horses. So, too, roller bearings are of great value on trucks and transfer tables around shops, as they are usually pushed by man power and a saving in the resistance is a manifest advantage.

On the other hand, when ascending heavy grades where the total resistance is made up largely of the resistance due to the grade, the roller journal can only save a percentage of a small part of the resistance. Again, when starting a train rapidly from a station, the inertia of the train makes up the major part of the resistance, and this is not affected in any way by the use of roller bearings. The inertia is the same whether the bearings have rollers or are for ordinary journals. The saving in the use of the roller bearing under these conditions is only a percentage of a small part of the total resistance. At high speeds on level tracks the resistance of railroad trains is made up of head air resistance, journal friction, rolling friction and flange friction. At extremely high speeds the head air resistance is considerably greater than the journal friction, and as the air resistance is not reduced by the use of roller bearings, the saving due to such bearings is, as in the other cases cited, only a percentage of a small part of the total resistance.

The practical value of a roller bearing is one thing, and its effect on journal friction is quite another. Probably at any speed the roller bearing will reduce the frictional resistance. Common sense would tell us that; but the practical value of such reduction depends wholly upon the reduction of the total resistance. That is, while a roller bearing may reduce the journal friction as much as 50 per cent., yet it would reduce the total resistance but 5 per cent. on a one per cent. grade, and less than that in starting trains rapidly away from a station where the inertia of the train is the principal resistance. In case of high speeds, such as 100 miles an hour, the roller bearing might reduce the roller friction still as much as 50 per cent. and yet reduce the total resistance perhaps but 6 or 7 per cent.

As we have said before, no one knows just how much the journal friction *is* reduced by the use of roller bearings at high speeds, but it is logical to reason that at any reasonable speed a roller bearing will reduce the journal friction considerably, as it changes the character of the contact from a sliding contact to a rolling contact, which in every case so far tried has reduced the friction of bearings.

Private Cars.

The Pillsbury-Washburn Flour Mill, of Minneapolis, has been trying for some time to get the railroads to carry flour in cars belonging to (or leased by) the Mill, but the roads have steadily refused to use the cars, their own equipment being sufficient to accommodate all freight offered; and the Mill has finally entered a suit in the United States Circuit Court against the Chicago, Milwaukee & St. Paul. It is in the form of a petition for mandamus, which recites that the road receives freight from other concerns and permits them to ship in special cars: and it instances oil cars, coal cars, beef cars, and stock cars. It is asserted that the petitioners have been put to much loss and inconvenience in using ordinary cars to ship flour and often have had it damaged by dirt. The inconvenience and loss due to reloading at Chicago for Eastern points is mentioned. A more rational argument, which has been spoken of in the newspapers, but which seems not to have been mentioned in the formal complaint is that the road is sometimes short of cars. This point, however, would be more effective in the fall than at this season.

It is to be hoped that this case will be well tried, for the subject is one which needs a thorough airing. On the technical points set up by the complainants, the railroad could probably make a pretty strong defense. Millions of barrels of flour have been shipped in cars of average cleanness, and many hundred consignees can testify that the damage from dirt, transferring and all other causes is infinitesimally small; moreover the Mill Company's cars would soon be as dirty as other people's unless they were regularly returned empty, and the railroad can very reasonably argue that to do that would often be wasteful.

But the real point at issue is whether it is for the public interest for railroads to haul a miller's cars, and, looked at in this way, the allegations about refrigerators and stock cars are frivolous, for these are really special cars, while a plain box car, to carry flour, is not such. The owners of cars fitted up with special devices of real utility have a considerable right, in equity, to have their claims recognized, for they have generally been in advance of the railroad companies in furnishing needed improvements; but a man with a common freight car has no such plea to offer.

Railroads waste a good deal of money in paying grossly exorbitant rentals for private cars, such as refrigerators for the Chicago meat shippers, for instance; and the defendant in this case has the reputation of having made one of the most vicious contracts of that kind; but whether the Pillsbury-Washburn mill can get any benefit from that fact in this particular case remains to be seen. Whether the mill people know that private car companies pay dividends of 50 per cent. a year we cannot say, but as they are lively Western business men and read the papers we presume they do; and when they come into court they will probably be asked whether a hankering for that kind of dividend for themselves had anything to do with their present enterprise. The defendant will probably wish to know who owns the "Eureka Transportation Company," which furnishes the flour cars. But whether he asks the question or not, it is to be hoped that the Court will bring out the facts and also all other facts available concerning private car companies and the way they get fat on railroad earnings, for there are a good many railroad managers who believe that they work serious injury to the railroads; and everyone interested knows that they have in many cases been the means of unfair discrimination.

April Accidents.

Our record of train accidents in April, given in this number, includes 47 collisions, 86 derailments and 10 other accidents, a total of 143 accidents, in which 30 persons were killed and 138 injured. The detailed list, printed on another page, contains accounts only of the more important of these accidents. All which caused no deaths or injuries to persons are omitted, except where the circumstances of the accident as reported make it of special interest.

These accidents are classified as follows:

COLLISIONS:	Rear.	Butting.	Crossing and other.	Tot'l.
Trains breaking in two	1	..	..	1
Misplaced switch	4	..	3	7
Failure to give or observe signal	3	..	1	4
Mistake in giving or understanding orders	..	6	..	6
Miscellaneous	6	1	2	9
Unexplained	6	4	10	20
Total	20	11	16	47

DERAILMENTS:			
Broken rail	2	Loose deadwood	1
Loose or spread rail	3	Misplaced switch	13
Broken bridge	2	Careless running	4
Broken wheel	3	Animals on track	5
Broken tire	1	Landslide	4
Broken axle	1	Washout	2
Broken truck	2	Malicious obstruction	1
Broken drawbar	3	Wind	2
Fallen brakebeam	4	Unexplained	30
Broken car	3		86

OTHER ACCIDENTS:	
Boiler explosion	3
Broken side rod	1
Other causes	6
	10
Total number of accidents	143

A general classification shows:

	Collisions.	Derailments.	Other acc'd'ts.	Total.	P.c.
Defects of road	..	7	..	7	6
Defects of equipment	1	18	4	23	17
Negligence in operating	26	17	1	44	30
Unforeseen obstructions	..	14	5	19	13
Unexplained	20	30	..	50	34
Total	47	86	10	143	100

The number of trains involved is as follows:

	Collisions.	Derailments.	Other acc'd'ts.	Total.
Passenger	16	23	6	45
Freight and other	64	63	4	131
Total	80	86	10	176

The casualties may be divided as follows:

KILLED:	Collisions.	Derailments.	Other accidents.	Total.
Employés	7	19	4	30
Passengers	..	4	..	4
Others	5	..	..	5
Total	12	23	4	39
INJURED:				
Employés	37	64	6	107
Passengers	13	11	..	24
Others	4	2	1	7
Total	54	77	7	138

The casualties to passengers and employés, when divided according to classes of causes, appear as follows:

	Pass. killed.	Pass. injured.	Emp. killed.	Emp. injured.
Defects of road	1	..	1	3
Defects of equipment	..	..	6	12
Negligence in operating	..	13	8	39
Unforeseen obstructions and maliciousness	3	5	6	15
Unexplained	..	6	9	38
Total	4	24	30	107

Twenty three accidents caused the death of one or more persons each, and 35 caused injury but not death, leaving 85 (59 per cent. of the whole) which caused no personal injury deemed worthy of record.

The comparison with April of the previous five years shows:

	1892.	1891.	1890.	1889.	1888.	1887.
Collisions	47	67	64	36	49	28
Derailments	86	108	67	52	83	58
Other accidents	10	6	4	5	4	4
Total "	143	181	135	93	136	90
Employés killed	30	52	13	22	35	36
Others "	9	4	2	23	9	5
Employés injured	107	103	81	60	107	74
Others "	31	49	59	26	84	34
Passenger trains involved	45	53	45	43	46	26
Average per day:						
Accidents	4.77	6.03	4.50	3.10	4.53	3.00
Killed	1.30	1.87	0.53	1.50	1.40	1.37
Injured	4.60	4.97	4.67	3.77	6.20	3.60
Average per accident:						
Killed	0.272	0.309	0.111	0.483	0.308	0.455
Injured	0.972	0.823	1.037	0.924	0.368	1.200

The four passengers killed in April were all riding in freight trains in charge of freight, so that as far as passenger trains are concerned the somewhat exceptional record of safety that began with February has been kept up. The month of May will change it, however; and one of its worst accidents is of a kind similar to that at Black Rock, Conn., reported in the list now printed. We mean collisions happening on the first day of a new time table and due, presumably, to carelessness on the part of trainmen in fixing the new schedules in their minds. Accidents from this cause are reported somewhere about every spring and fall and, like the cases due to forgetfulness on the part of an engineman or a conductor of something which *both* of them are required to remember, they seem to indicate that there are still many superintendents who take a good deal more pains to enforce the forms of instructions than to see that the substance of their orders is understood. The rules concerning the delivery of new time tables and the accompanying regulations designed to insure a receipt from each conductor and engineman before the table goes into effect have been strengthened and perfected so that now we never hear of a slip at this

point. By this the superintendent technically clears himself from all responsibility, and so may go to bed with perfect calmness on the night before the change in time, if he is satisfied with mere documentary evidence that everything will run smoothly. But a very ordinary kind of experience ought to teach any one that to get men to read the tables *through*, and to do this with sufficient care so that they will not go away laboring under any misapprehensions, it is necessary to see that they cultivate the habit of studying columns of figures more thoroughly and easily than some enginemen do. An engineman or conductor ought to be sufficiently familiar with the time tables to quickly comprehend a new one even if it be compiled blindly (as some tables are); but on most roads a small percentage of the men are not thus mentally alert, and they ought to be trained. If these men do correctly understand a new time table it is quite likely because the changes are all easily discerned or because some more intelligent man aids them in the study.

At Philadelphia on the 28th a steam fire engine was demolished by a switching locomotive at a crossing, and two of its men injured. At Hell Gate, New York City, on the 27th a float carrying 20 freight cars, some of them loaded, broke away from the tug which was towing it, and ran upon a rock and sank.

Iron and Steel in 1891.

The statistical report of the American Iron and Steel Association for 1891 shows a production of pig iron 10 per cent. less than in 1890, it is true, but nine per cent. more than in 1889, and 28 per cent. more than in 1888, when it was greater than ever before. Those who look upon last year's decrease as a disaster should cast their eyes back a little. The production has more than doubled since 1885, and it is not in the nature of things that a growth should continue at that rate indefinitely. We are now producing substantially all of our pig iron, and the consequence is that hereafter the growth of the industry must be limited to the increase in consumption. And the consumption of iron, as of other materials of construction, is liable to great fluctuations. In flush times there is much new construction; then it is likely to be overdone, and for a time there is very little new construction, and the demand for materials of construction is limited chiefly to what is required for renewals and repairs. Thus iron manufacturing in almost all countries suffers great vicissitudes, and in a country like this, where we sometimes build in a year 12,000 and sometimes only 4,000 miles of railroad, and where other construction usually fluctuates with railroad construction, it is not likely to be exempt from them. The iron master cannot expect to make money every year; but as he can sometimes make two years' profits in one year, he has his compensations.

The decrease in pig iron production last year was chiefly in Pennsylvania, Ohio, New Jersey and West Virginia. Of states producing more than 100,000 tons, only Virginia and Tennessee made more than in 1890. The Southern States, as a whole, however, suffered very little decrease, and their proportion of the whole production was 20.6 per cent. last year, against 18 per cent. in 1890. Nearly half of this Southern production is in Alabama.

The production of Bessemer steel decreased 12 per cent., and was wholly due to the reduced consumption for rails. The production of the latter fell off 574,785 long tons (22⅔ per cent.); of the latter, only 441,454. Thus the consumption of Bessemer metal for other purposes evidently increased materially. But this has been going on a long time. Ten years ago the production of Bessemer ingots was only 17 per cent. more than the production of Bessemer rails, and the excess was less than 240,000 tons. Last year for the first time the Bessemer rail production was less than half of the total Bessemer production, and the excess of ingots and direct castings over the Bessemer rail production has been for six years in gross tons:

1886.	1887.	1888.	1889.	1890.	1891.
691,487	834,127	1,123,097	1,420.147	1,821,033	1,954,264

If there were no waste in rolling rails from ingots this would show almost exactly the increase in use of Bessemer steel for other purposes than rails, and as it is it indicates it very closely. It is shown to have been very great and rapid. On the other hand the production of Bessemer rails was greatest as far back as 1887, and it was nearly as small last year as in 1882. Deducting for the new railroads built during the year, we have about 865,000 tons available for renewals of about 210,000 miles of *track*, or 4⅛ tons per mile. The quantity apparently available for renewals in 1890, was about 1,311,000 tons, for about 203,000 miles of track, or nearly 6½ tons per mile, indicating that the railroads did not make the usual rail renewals last year. The Union Pacific has reported an expenditure of only $23.50 per mile of road for rails for track renewals in 1891, which indicates a consumption of considerably less than one ton per mile.

The production of open-hearth steel increased last year as it long has, the production having been in gross tons:

1885.	1886.	1887.	1888.	1889.	1890.	1891.
133,376	218,973	322,068	314,318	371,543	513,232	579,750

Thus the production last year was more than four times as great as in 1885. There are thus several branches of iron manufacture which were more active than ever before.

Mr. Swank, the Secretary of the Iron and Steel Association, who is doubtless the best authority on the condition of the iron industry, reports that it is still unsatisfactory. "Our pig-iron capacity is far beyond our present needs," he says, which is likely to be the case not long after a very profitable season in the iron industry.

The Canadian Pacific had on the 5,766 miles of railroad which it worked last year a traffic equivalent to the movement of 76 passengers and 330 tons of freight daily over the whole system, which is a very light business, as was to be expected. We must not suppose, however, that the Canadian Pacific is wholly in a wilderness, or was when it was first built, as were most of our Pacific railroads. On the contrary, it has 2,800 miles east of the Great Lakes, just north of New England and the Middle States; and there, where nine-tenths of the population of the Dominion is, doubtless it finds its chief traffic and earnings. The inclusion of these lines prevents any fruitful comparison with our Pacific railroads. Fully 3,300 miles of its lines are east of the eastern terminus of the Union Pacific. A great part of its Eastern lines, however, are in a very thinly populated country, and very few parts of its line, doubtless, have what would be considered a large traffic on lines so far east on this side of the border. In the whole system the gross earnings last year were $3,570 gross and $1,300 net per mile. The latter is 5 per cent., or less than $28,000 per mile; but the Canadian Pacific Company had the good fortune to have a large part of its cost paid by the Dominion, and it has unusually light fixed charges, amounting last year to only $800 per mile of road. Its great land grant yields but small direct returns, but a great increase in sales is reported for the first four months of this year. The traffic and earnings have grown with considerable rapidity. Per mile of road the passenger traffic has grown nearly 30 per cent. since 1888, and freight traffic 52 per cent. The expense of maintenance of way last year was $437 per mile of road; the cost of motive power $7,958 per locomotive; of maintenance of cars, $46 per car—all very small amounts, as may be seen by comparison with the expenditures of the Union Pacific in the same year, which we showed (May 13) to have been $710 per mile for maintenance of way, $9,110 per locomotive for motive power, and $107 per car for maintenance of cars. It is also noticeable that the average gross earnings per mile ($3,936) of the branches and leased lines of the Union Pacific are 12 per cent. greater than those of the Canadian Pacific, trunk lines and all; but the net earnings of the latter were $1,300, against $974 on the aforesaid lines of the Union Pacific, or 43 per cent. greater. If the fixed charges of the Union Pacific were as light per mile as those of the Canadian Pacific it would have paid nearly 4 per cent. dividend on its large share capital.

We give nearly in full this week a paper by Mr. F. M. Rites on the "Steam Distribution in a Form of Single Acting Compound Engine," read before the American Society of Mechanical Engineers at the San Francisco meeting. This paper gives some facts about steam distribution in compound engines, and explains so well the necessary conditions to the acquirement of that wide range of economical working so essential in locomotive work that it will be found useful to all who are interested in compound locomotives. The type of steam distribution described in the paper gives from actual tests a range of action from 100 to 210 H. P. at a constant speed (about 100 per cent. variation from the lower limit), with a change in water per horse power of only 0.9 of 1 per cent. With a range in speed such as is common in locomotive action, the range in power would be very much greater with the same small change in the water rate. This is a type of steam action much to be desired for railroad work. The facts and reasoning set forth in the paper are wholesome reading for designers of compound locomotives, and if the principles laid down were followed we should have less monstrosities of design than we now see in some of the compound cylinders and valve gears running here and in Europe.

The New York state law regulating the hours of railroad employés has gone into effect, Gov. Flower having signed it on Friday of last week. We have not yet seen the full text of the bill, but its principal feature is that making ten hours' work, performed within twelve consecutive hours, a "day's work," and requiring all time beyond this to be paid for as "extra." It remains to be seen how such a law will work. Most statutes of this kind have proved ineffectual because of various loopholes left in them by careless legislators, or else because their terms made them unenforceable in the nature of things. The principal roads of New York are disposed to be pretty fair with their trainmen, however, and the law may not be tested at all. It is vicious in principle whether we test it or not, for it attempts to compel payment by the hour for work which can be most economically and efficiently done by the piecework system. Trainmen ought to be paid by the trip, with hour rates for extra work only on rare occasions. Extra pay for detentions constitutes too strong a temptation to waste time, if it is allowed all the time.

The first reorganization scheme of the Richmond & West Point Terminal Co. has failed of success, owing to the cruel refusal of the well secured creditors of this company to help pay the debts of its shareholders, and so enable them go on with their great speculation, which is at present threatened with disaster. A new plan has been drawn up, the particulars of which at this writing are not yet fully known, but which all accounts, differing in some particulars, agree in describing as calling upon the people who owe the money—the Terminal Co. shareholders—for the money to pay their debts, and enable them to secure any future profits which their great enterprise yield hereafter. In this respect it is an immense improvement on the first scheme, which seems to us one of the most discreditable ever proposed by respectable financiers.

The Austrian State Railroads introduced their low zone tariff in June, 1890, and a greatly reduced freight tariff last year. The report for 1891 shows a gain of 1½ per cent. in gross earnings over those of 1890, but a decrease of 13½ per cent. in net earnings. The larger part of the increase in gross earnings was from passenger traffic, and the increase in freight earnings was trifling; but a decrease of $1,600,000 had been estimated as the result of the decrease of freight rates in this the first year of their working. The net earnings were equal to 2.39 per cent. on the cost of the State Railroads.

NEW PUBLICATIONS.

Les Chemins de Fer et les Tramways. Par Adolphe Schœller, Inspecteur à la compagnie de chemin de fer du Nord. Paris. J. B. Baillière et fils.

This is a little book of 358 pages belonging to a series called the "Contemporary Scientific Library," and intended as a popular exposition of the latest improvements in the construction and operation of railroads. There have been some other "popular" books on railroads, which have left the impression that the authors made their first acquaintance with the subject while compiling their books, and it seems that 358 pages afford scant room to give much information on so vast and complicated a subject. But a perusal of the book shows that Mr. Schœller not only has the knowledge which might be expected of a practical French railroad man, but that he has been a close student of the railroad practice of other countries, and knows the reasons of many methods and appliances which are little if at all known in France. In fact, there are probably few railroad men, not to say general readers, who could not learn much from this little book. American practice is frequently referred to, and is generally intelligently described, the errors we have detected being chiefly the acceptance as actual or ordinary practice of certain inventions which made some noise at one time, but hardly got beyond the experimental stage. And the book is well down to date. Not only are the latest French innovations described, but such comparative novelties as our electric street railroads, and even the "Greathead" underground line in London. Altogether it is a very creditable book.

How to Run Engines and Boilers. By E. P. Watson, Editor and Proprietor of the *Engineer*, 150 Nassau street, New York. Price $1.50.

This is a book of 125 small pages, the purpose of which is to help young men who have the care of stationary engines and boilers. The various chapters cover methods of cleaning boilers, and the use of scale preventers, the functions and diseases of mud drums, grate bars and tubes, and in fact cover quite thoroughly the details of taking care of and running boilers. The engine also is treated in considerable detail, the idea being, not to develop the theory of the steam engine, but to teach one how to keep it in order. On the whole, the book appears to be thoroughly practicable and free from misleading errors.

Timber Physics; Part I. Preliminary Report. Compiled by B. E. Fernow, Chief of Forestry Division, United States Department of Agriculture. Washington, Government Printing Office, 1892.

This bulletin discusses the need of the investigation of physical properties of useful timbers, gives an account of the historical development of the science of timber physics, and tells of the organization and methods of timber examinations in the Division of Forestry. The work at the test laboratory at St. Louis, Mo., is described by Prof. J. B. Johnson. Our readers are already quite familiar with this work from articles that we have published heretofore.

State and City Supplement of the *Commercial and Financial Chronicle.*

Messrs. William B. Dana & Co. issue, under date of May 21, another State and City Supplement. The first issue of this supplement appeared a number of months ago. It contains minute information of municipal bonds and securities of that class, for the whole United States. A pretty full index makes the information easily available.

Messrs. John Wiley & Sons announce as in preparation, "Geodetic Surveying," by Prof. Mansfield Merriman.

TRADE CATALOGUES.

The Nathan Manufacturing Co., of 92 and 94 Liberty St., New York City, issues an illustrated railroad catalogue under date of May 1. This shows the various injectors manufactured and sold by the company, with their attachments and parts, also lubricators, oil cups etc. The catalogue is completely and handsomely illustrated.

The United States Metallic Packing Co., of Philadelphia, Pa., issues a small catalogue showing the application of its packing for piston rods and valve stems in locomotives, stationary and marine engines. The few cuts that are published show the arrangements very clearly. Much the greater part of the catalogue is given up to a long list of those who use these packings. This list fills 37 pages.

Firebox Steel.

(*Continued from page 391.*)

Another objection to laminated firebox plates is the impaired conductivity of such plates. It is a virtue of metals to conduct heat more freely and more rapidly than other non-metallic substances. But it is obvious that in order to conduct the heat freely there must be continuance of the structure. Supposing it were possible to interpose a layer of asbestos through the middle of the plate, then the fireside of the plate would be burned before the opposite side is hot enough to impart its heat to the water. An air space would be a similar obstacle to the proper conduction of heat, though in a lesser degree. To the degree, therefore, to which the continuity of structure in a firebox plate is disturbed, to that degree the usefulness of that plate as a conveyor of heat will be impaired. This impaired conductivity in turn tends to a more speedy destruction of the plate, since, other things being equal, overheating, and consequent greater expansion of the metal on the fire side is more liable to occur. Carefully conducted experiments have shown that blowholes, flaws, bits of slag, etc., in telegraph wire considerably retard the flow of the electric wave. Considering the phenomena of heat motion and electric motion analogous in their nature and conduct, we can easily conceive how the laminations in a firebox plate interrupt and retard the heat wave in its flow through the metal.

If the above reasoning is correct then we can hardly doubt the cause of laminated firebox plates being short-lived and expensive to the locomotive builder. Laminated steel gives as good tensile test and elongations, is rolled easier, flanges "very much like iron" according to the statement of the boilermaker, who prefers such steel because homogeneous steel works "stiffer."

Laminated firebox plates are also objectionable and expensive on account of the decreased resistance such steel is able to offer to the destructive effects of expansion and contraction. There being no such a thing as fibre in steel, in the sense as we speak of fibre in iron, any injury to the metal is carried through the mass of steel more quickly and readily than through iron. If we break the outer "bundle" of fibre in a good piece of iron, we find the other uninjured "bundles" or "strains" of fibres to do the work, with a diminished strength of course.

The homogeneity of steel makes the metal stronger and thus compensates, through its greater power of resistance, for this valuable feature of fibrous structure in iron, although, as already remarked, and as is well known, steel breaks more easily if once injured. Now then, put a steel plate in a firebox, which is already weakened through want of continuity of structure by laminations, and then subject such a plate to continued movements, however small, in various directions, as the intensity of the heat, expanding the metal, increases or decreases, and we need not wonder why laminated steel plates give such poor satisfaction. All the more so if the water is impure and scale is formed on the waterside of the firebox.

Among the factors of destruction that have croped out during the long use of steel for fireboxes, with tolerable certainty, amid the multitude of complicated circumstances and conditions, this one has been found; that, other things being equal, the life and mileage of a steel firebox is proportional to the homogeneity, viz., freedom from laminations, of the steel used. It may here be remarked that the progress in steel making of late years tends to a more homogeneous and, if we may call it so, a more fibrous steel of the grade used for fireboxes. This is particularly the case with open hearth steel and is due to improved methods, increased skill and knowledge on the part of the steel maker, increase in size of ingots, etc. At the present advanced stage of steel making there is really no excuse for firebox-plates with laminations or want of uniformity being in service. The holding power of staybolts in a laminated steel plate would naturally be not as good as in a solid plate. The thread being broken by the passing through, transversely, of flaws.

Nearly all of the trouble arising from laminations could be avoided if 25 per cent., the top portion, of every ingot intended for firebox material was cut off. This would result in more scrap in the mill, which, however, could hardly be considered a serious matter, in comparison with the benefits derived and saving made in repairs, delays and annoyances.

The foregoing does not take into consideration the want of uniformity of structure that may exist in a homogeneous steel plate, due to unequal heating and cooling, local hammering or segregation in the ingot. The first may be caused in the mill or boiler shop through carelessness or undue haste. Heating the ingot too rapidly, or with a short, cutting flame, will overheat the outside while the interior is comparatively cold. In rolling such an ingot the metal does not stretch uniformly at each pass. The surface is forced way ahead of the colder and, therefore, harder central portion which has a tendency of tearing the mass, instead of compressing the metal, and making it flow before the rolls in a natural way. The unequal heating in the boiler shop of the plate may also cause inequality of structure, though, the softer the metal, the less perceptible these effects. Local hammering without subsequent annealing will cause internal strains, which, if the structure of the metal is granular, may become troublesome.

Segregation of the chemical elements of the steel and their concentration in local spots is of frequent occurrence.

However, since firebox steel, if it is specified and paid for as such, is chemically purer than flange steel, there is less of this defect to be apprehended. Firebox steel from a reputable maker who understands his business and does not sacrifice skill, knowledge, reputation and honor for the prosperity of the hour and temporary high dividends, is a very uniform, reliable product, a piece of metallurgical science of a high order and an economic factor of no mean value and importance.

Maintenance of Way, Eastern Railroad of France.

The methods adopted in the maintenance of way department of the Eastern Railroad of France make the subject of a long article in a recent number of the *Annales des Travaux Publics* by Mr. Freund, the engineer in charge of such work. The usual method of keeping up the track in France is to make repairs at separate places along the line, whenever they seem to be needed. Mr. Freund, however, as long ago as 1865, proposed a different plan, which was adopted in 1885 on the entire system with which he is connected, and consists essentially in periodical revisions and repairs of all the roadway, in the same manner that the highways of that country are to a great extent maintained. The methods employed in such a revision are as follows:

The existing ballast is first worked up from each end of the ties toward the centre, where a heap about 1 ft. 7 in. wide is formed. The surface of the material descends under the rails and ties in such a manner that tamping will be easy, the sides sloping away toward each tie. The amount of the depression on each side of the tie varies from 0.8 in. in gravel to 2 in. in broken stone. The ballast that has been removed is placed between the rails or on the sides of the track as near to the hollows as possible and out of the way of passing trains. Before loosening the roadbed all weeds, grass and roots are carefully removed and also the mud that collects in some places. This rubbish is collected in little piles along the line and is removed at the close of the day or as soon as possible, to places designated by the foremen, never being thrown on the sides of the roadbed or into the ditches. The workmen are divided into gangs, to each of which is given a day's work, divided equally among the men. The foremen report to the superintendent the names of those men who finish last and first the work assigned to them. The foremen themselves have a shorter length to cover in order that they may inspect the rails and ties and determine the amount of subsequent work that will be necessary.

When this preliminary labor is completed the rail fastenings are cleaned by means of a wire brush, and the superintendent examines them to determine what alterations are necessary. At each joint and half rail length the gauge and inclination of the rails is tested as well as the condition of the fastenings. The repairs are indicated by chalk marks, different symbols calling for altering the position of the tie, replacing a tie or rail, widening the gauge, narrowing the gauge, fixing the chairs, lowering the rail, altering the position of the ties after examining the fastenings, and turning ties, the two last being used only in occasional repairs.

The men begin the work indicated as soon as the material arrives, and when they have finished it the condition of the track is required to approach within certain fixed limits to the theoretically perfect line. The lateral displacement of the ties and the longitudinal displacement of the rails, for example, may vary within 0.4 to 0.8 in., and the inclination of the rails may vary 0.012 in. on either side of the exact amount. The variation in the gauge may be 0.2 in. too great or too small, provided the fastenings are perfectly firm. Few rails are replaced during general repairs, for the policy of this road is to replace a rail as soon as it shows defects. The general revision usually occurs at a time when the rails are worn out, and it is consequently necessary to relay the entire section.

Rails are removed as soon as the head is worn down 0.39 in. for steel sections weighing 60.5 and 72.6 lbs., and 0.98 in. for those weighing 88.7 lbs., or when the wear in other places has been sufficient to produce insecure joints. Moreover, they are replaced if the sides of the head become broken or the top of the rail wears unevenly along its length, or vertical cracks are found. Ties are replaced when found to be split and crushed or worn to less than 3.54 in. under the rail.

The vertical displacement of rails is considered allowable when it does not exceed 0.39 in. on main lines and 0.79 in. on branches in a length of 16.4 ft. A difference of 0.39 in. in the transverse level of the rails is also allowed.

The interval between successive "general" repairs, such as those described above, has been determined by experience to be as follows:

Main Lines—One year on track over which more than 15,000 trains pass annually, equivalent to 40 trains per day, two years on track over which from 7,500 to 15,000 trains pass; three years on track over which from 2,500 to 7,500 trains pass annually, equivalent to from 7 to 20 trains per day; six years on track having less than seven trains per day, until the ties become so bad that 10 per cent. must be removed when the repairs are made every three years.

Branch Lines—One year on track having more than 30,000 trains annually, equivalent to 80 per day; two years on track having from 15,000 to 30,000 trains annually; three years on track having from 2,500 to 15,000 trains annually, equivalent to from 7 to 40 trains per day; six years on track having less than seven trains per day, and in yards and about stations where the traffic is irregular. This applies especially to track consisting of steel rails of 60.4 lbs., with suspended joints and iron rails of 70.5 lbs., with supported joints, laid on creosoted chestnut or beech ties on the greater part of the main line. It is not claimed that these are the only repairs necessary, but it is believed that in this way the occasional work is reduced to a minimum.

In carrying out this work it is customary to divide the men into gangs of 6 or 7 on the chief main lines, 5 or 6 on main lines of less importance, 4 or 5 on lines where the traffic is light, and to give to these gangs sections of 4.66, 6.21 and 9.32 miles respectively. Where the traffic is very heavy or about stations, the sections are sometimes reduced to 3.11 miles, or to the yard itself. The number of men is determined by means of the following formula:

$$X = (C + n\ V)\left(1 + \frac{2(L-5)}{100}\right)$$

In this formula X represents the number of men at work during the entire year per kilometre, C is the number of men necessary to keep up the road where traffic is very light, and is assumed at 0.3 to 0.25 for double-track roads and 0.2 to 0.15 for single track; n is the number of trains per year, taking 1,000 as unity; V is the number of men per 1,000 trains necessary to handle the traffic, and varies from 0.02 on unimportant to 0.025 on important lines; L is the length of the division in kilometers. The factor $2(L-5) \div 100$ represents the lost time going to and from the place of work when the sections are more than 3.11 miles long. When the force exceeds more than 1.5 men per kilometre on sections more than 3.11 miles (5 kilometres) long, it is considered that this loss in time is made up by the size of the gangs.

The work is divided according to the seasons as follows: January, repairs of the hedges and fences; February and March, removal of brush and weeds from the roadbed and slopes; March 15 to Oct. 15, general revision of the principal lines with an interruption during the heated summer months; July 15 to Aug. 15, cleaning out the side ditches, repairing signals and telegraph lines, and similar work; October, November and December, general revision of the branch lines; December, inspection of the joints on all the lines. Among the special labors of the maintenance of way department is the inspection of the track three times a week at night, and the daily inspection during the day time, partial repairs of the track at all seasons when necessary, and other duties similar to those of the maintenance of way department in the United States.

Each workman finishes from 2 to 4 ft. of track per hour, depending upon the nature of the repairs. Where the ballast is gravel the average length is 3½ ft., while with broken stone it is a little less than 2½ ft. The cost of the work is about 2.14 cents per foot with labor at 6 to 7 cents an hour. Each laborer generally completes the equivalent of 0.621 to 0.932 miles per year. The daily reports of the foremen give the length of line completed, the amount of material used, and the time spent on the different kinds of work. These reports are passed along through the different grades of chiefs until they reach the superintendent of the section, who is thus enabled to keep a regular account of the extent and cost of each class of work performed by his men.

The article closes with a statement of the advantages and disadvantages of this system of general repairs. This it is unnecessary to reproduce, as maintenance-of-way engineers on any good line are able to decide for themselves. It should be remarked, however, that the number of days' labor required to maintain one kilometre of track on the Eastern Railroad under a traffic of 1,000 trains has been reduced from 70 in 1874, when the piece system of repairs was in vogue, to 40 in 1890, or about 57 per cent.

Foreign Railroad Notes.

On May 1 a fast train was put on the Prussian State Railroads between Berlin and Cologne, which may fairly be described as an American "limited" train. The train is made up entirely of new passenger cars on four wheeled trucks, end vestibule platforms and a *side* passage, the German roads not admitting of cars as wide as ours. They are for first and second-class passengers only, and the seats are all numbered, and can be secured at the terminal stations beforehand on buying a ticket and paying a mark (24 cents) in addition, at least half an hour before the train starts. Passengers must take their chances if they do not secure seats in advance. One car in each train has a buffet from which passengers in the compartments are served with hot and cold dishes and beverages. As soon as the cars can be provided a simi-

lar train is to be put on between Berlin and Frankfort-on-the-Main. These are long runs of some 10 hours, and they are likely to be among the most comfortable in Europe with the new cars. Trains of this kind have been publicly advocated by Mr. O. W. Petri, late engineer attaché of the German Embassy in Washington.

We noted recently that a German railroad man, referring to the statements of Petri, Von Borries and others of the advantages gained in this country by adopting heavy locomotives and big trains, declared that greater economy could be had in Germany by doubling the speed and taking light loads. Von Borries now writes to the *Journal* of the German Railroad Union that with the powerful American locomotives not only are the trains much heavier than in Germany, but that they run much faster. Still another writes that the American plan of running a locomotive with more than one crew has been practiced on a certain Prussian line whenever traffic pressed, for more than seven years, and after the first few trials, substantially without any difficulty. That the practice has not extended in Prussian railroad service he says, is partly because the stock of locomotives was generally sufficient without it, and the old stock of engines must be worn out to make room for improved kinds, and partly because on many lines there was no service by both day and night.

The reports of traffic on the Russian railroads have special interest, because of the disaster to last year's crops. The report for December, however, shows a large increase (21 per cent.) over 1890 in the number of passengers carried, and a decrease of only 2.6 per cent. in the quantity of freight. There was, however, a decrease of 11.3 per cent. in the total earnings. For the whole year 1891 the number of passenger journeys was one per cent. greater than in 1890; the number of tons carried 2½ per cent. greater, and the gross earnings three per cent. greater. The average earnings per mile were $7,831, and $40 more than in 1890. The mileage worked has increased since 1887 from 16,911 to 18,240 miles; the number of passengers meanwhile has increased 16 per cent., the tons of freight 16⅔ per cent., the gross earnings 14 per cent., and the earnings per mile 3⅔ per cent. The latter have varied little from year to year, but were largest in 1888. Last year it is reported that 1,080,000 tons of grain were carried at the very low "famine rates."

Russia has a technical school, something like the French School of Bridges and Highways, called the "Emperor Alexander I. Institute of Road Engineers." The graduates of this school alone have been eligible for all the higher railroad offices, whether in construction, operation or administration. Engineers graduated at any other institution, Russian or foreign, if they wished to serve on Russian railroads, were compelled to enter the Institute of Road Engineers in St. Petersburg, take a three-years' course there, pass the regular examinations, and wear the uniform prescribed for its graduates. This monopoly of the Institute engineers has now been broken by an edict issued Feb. 28 last, which authorizes the Minister of Transportation to appoint other engineers with the title of "Engineers of the Ministry of Transportation," who shall be eligible the same as the "Road Engineers" graduated from the Institute. These engineers will form a government corps, but may be permitted to enter the service of private corporations and individuals, just as engineers of the Corps of Bridges and Highways and of Mines are now in France, on obtaining permission from the Minister. And their service on other than government works will count the same as if on such works to entitle them to promotion, etc. The Minister gives notice that permission to enter such employment will be regarded as a special honor and privilege, to be granted only to those engineers who have especially approved themselves to the authorities; and he expresses the hope that while in such private service they will continue to serve the interests of the state—which not infrequently, it may be remarked, will be very different from those of the corporations in whose service these engineers will be.

The leading Austrian locomotive works reports that it turned out 57 locomotives and 37 tenders last year, against 39 engines and 7 tenders in 1890, the aggregate value of its production having been $707,700, against $506,520 in 1890. The prospects for the future have recently become less favorable. On all the railroads traffic has been decreasing, the first result of which is always the withholding of orders for new equipment. So far there have been orders for 30 locomotives and 16 tenders for this year's delivery. The net profits of the company last year were $76,993. This sufficed to pay all charges, the regular dividend of 5 per cent. and an extra dividend of 4 per cent.

The railroad system of France at the beginning of this year consisted of 21,528 miles of lines of "general interest," 2,033 miles of local railroad and 7.10 miles of street railroads. The additions in 1891 were 510 miles of road of "general interest," 135 of local railroad and 105 miles of street railroad.

The French *Journal des Transports* publishes sketches of the careers of some of the leading French railroad men, which may be interesting here. The General Manager of the Paris, Lyons & Mediterranean, the greatest of the French railroads, is Joseph Philippe Gustave Noblemaire, born 1832, graduated from the Polytechnic School as Engineer; candidate, 1853, appointed Engineer of Mines (which corps contains mechanical engineers largely), 1859; promoted chief engineer of the second class, 1891, and chief engineer of the first class (that is, in the Corps of Mines), 1889. Very early in his career he left the state service for railroad service; in 1862 was manager of the Northern Railroad of Spain, and in 1869 entered the service of his present company, as superintendent of its Algerian system; in 1873 was made assistant engineer in the superintendent's office in Paris; was promoted to be assistant superintendent in 1878, to be superintendent in November of the same year, and general manager in 1881. He is said to be "a persuasive speaker, and a man of learning."

Charles Marin, General Manager of the Western Railroad, born 1833, studied at the Polytechnic and also at the School of Bridges and Highways, where he distinguished himself. He entered the Corps of Bridges and Highways, and at once attracted attention by the construction of a lighthouse in Vendée. He entered the service of the Western Railroad in 1863 and first was engaged in the construction of some branches and stations. He was transferred from the construction to the operating department in 1869, became assistant superintendent in 1870, superintendent in 1873 and manager in 1874.

Malleable Iron As It Should Be.

There has been some controversy the last year about malleable iron as it is put on the market. The text-books state and the general opinion of mechanics is that malleable iron is malleable; that is, it can be twisted and bent almost as much as wrought iron without fracture. Some of the text-books give the tensile strength as high as 45,000 lbs. On the other hand, the tests made of malleable iron bought in the open market show that it is generally brittle, with a tensile strength not over 30,000 lbs., with little or no elongation. Sometimes a thin bar of it can be bent as much as 45 degrees without breaking. Some have been led to believe from their experience

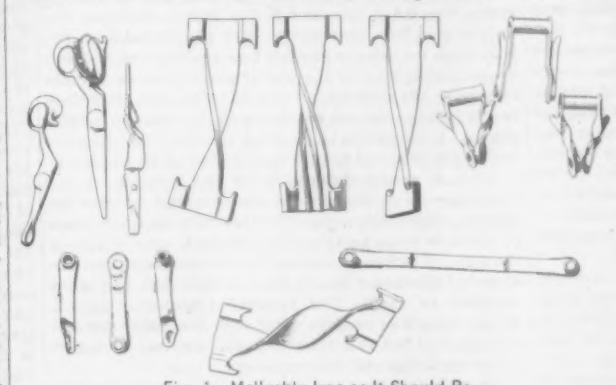


Fig. 1—Malleable Iron as It Should Be.

with malleable iron in the past two or three years that the text-books are wrong and that the old opinions about this material are faulty. Of course such a feeling is natural enough from the experience with some classes of malleable iron, but the fact remains that just as good malleable iron can be and is made to-day as ever was made, and the tensile strength given in the text-books is right for the best grades.

Probably there is no class of work which requires such good material as link-belt machinery. The links are subjected to severe strains and shocks, and of all materials that have been used for the purpose malleable iron of the highest grade has been found to be the best. To put on record and to show what is a good quality of malleable iron we give with this, engravings showing belt links and straps, and other small parts made from malleable iron and twisted and bent to an extent that

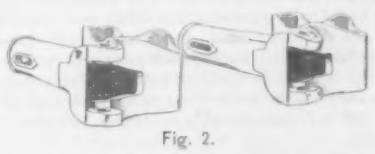


Fig. 2.

would severely test good wrought iron. The sides of the links have been twisted more than one full turn without fracture, and the eyes in the straps have been hammered until the sides came together without breaking. It is well known by those who have tried to heat malleable iron of the ordinary kind that the centre will melt out and leave a shell of the annealed exterior. The interior melts at a lower temperature than the exterior; therefore, a poor malleable iron cannot be welded.

In fig. 1, the shears shown have handles of malleable iron with steel blades welded on. One illustration shows the blades and handles welded together. This goes to show what it is possible to do with the highest grade of malleable iron, made, as it is understood, from a good grade of pure charcoal iron.

These castings were made by the Buckeye Malleable Iron Company, at Columbus, O., the makers of the Buckeye verticle plane car coupler. Fig. 2 shows one of these couplers cast from good malleable iron before and after bending the lugs. The tenacity and ductility of the material are shown by the bending of the lugs where the knuckle pivots. The lugs are driven together about an inch without fracture. This bending was done by hammering with a 20-lb. sledge until the lugs were in the position shown. A broken piece of material of the same kind shows that the annealing process was carried very nearly through the parts an inch in thickness, and throughout the broken sections there is none of that dead black looking iron common to the general run of commercial malleable iron.

These illustrations go to prove what we have said before that there is as much difference between good and bad malleable iron as between good and bad cast steel. Both need careful manufacture and good stock, and good castings can only be uniformly obtained from either by a system of careful inspection and test.

As a further contribution to this subject we add the following record of tests made of the product of the National Malleable Castings Co., of Cleveland, O. The tests were made Feb. 26, 1892, in the presence of Mr. John Mackenzie, Supt. M. P. N. Y. C. & St. L.; Mr. F. McMahon, Engineer of Tests, of G. W. G. Ferris & Co.; Mr. Theo. H. Curtis, Draftsman, N. Y. C. & St. L., and Mr. L. O. Rawson, of the National Malleable Castings Co.

Test No. 1.—A pair of centre plates; compression pressure, 400,800 lbs.; no fracture perceptible.

Test No. 2.—A pair of centre plates; compression pressure, 386,500 lbs.; no fracture perceptible.

Test No. 3.—One truck and casting; compression pressure, 207,600 lbs., commenced to buckle at inner webs; pressure of 257,700 broke through centre webs.

Test No. 4.—Tube, outside diameter, 3⅝ in., inside diameter, 2⅛ in., 18⅛ in. long; at pressure of 214,700, buckled and compressed to 17⅛ in.; at pressure of 300,600 lbs., bulged out of line ⅝ in., but did not show sign of fracture any place.

Test No. 5.—A Chapman jack No. 12, malleable iron, when tested, the screw was out of the nut 3⅝ in.; diameter of thread, 2⅛ in.; compression pressure, 128,800 lbs.; screw compressed, 9⅞ in., screw assuming a curve shape.

Test No. 6.—A Chapman jack, No. 30, top, base and nut malleable iron, casing wrought iron pipe (extra heavy), screw steel; diameter of screw 2⅛ ins., extended 1 in. when compression pressure of 128 800 lbs. applied; wrought iron pipe casing showed deflection in four places; no other defects perceptible in any other part of the jack. Total deflection 1¾ in.

Test No. 7.—One Butler drawbar attachment, No. 9, with standard draft spring enclosed, 6 in. by 8 in. double coil; cases bolted together, sitting upright on two steel columns; pressure applied on one sleeve to compress spring 42,950 lbs.; pressure continued to show resistance against thrusts from couplers or buffing to 200,400 lbs. when ends compressed ⅞ in.; pressure continued until 257,700 lbs. when end walls of drawbar attachment bulged ⅞ in.; no condemning fracture shown.

A further test is reported by Messrs. R. W. Hunt & Co. It was a test of the new malleable iron centre plate, interchangeable with the C., B. & Q. pressed steel pattern.

"We beg to make the following report on the malleable castings from the National Malleable Castings Co., Cleveland, O. They were placed between two solid blocks of oak, 5 in. × 15 in. × 2 ft., with countersunk holes to receive the castings, which fitted up closely to them. The load was run up to 166,000 lbs. when castings began to fail. It was then increased to 190,000 lbs. and then taken off, with the results as shown in castings."

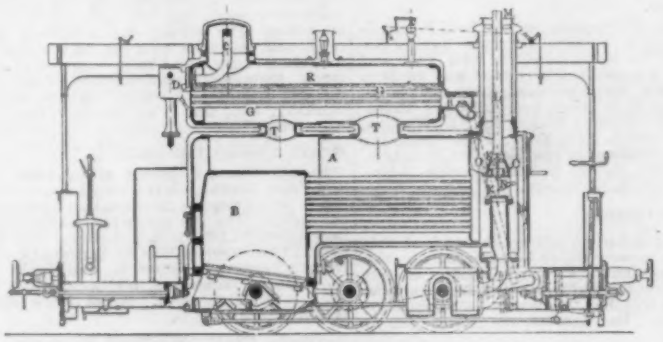
French Locomotive for Suburban Service.

During recent years there has been a considerable development in France of narrow and standard gauge railroads for local uses only. These roads are usually quite lightly built, with many curves and grades, and the financial returns have been unsatisfactory in many respects. Many of these roads occupy a field filled in the United States by electric lines, and the poor financial status of the French systems is ascribed to the defective motive power furnished. Steam is almost universally employed in some places, according to the well known "fireless" system of Mr. L. Francq, which has the advantage of operating without smoke, but requires frequent stations for recharging the boilers.

In order to retain the advantages of this "fireless" system and at the same time have the greater advantages of the ordinary locomotive, the engine described below has been designed by Mr. Léon Francq and Mr. Mesnard. According to a description in the *Génie Civil*, the boiler has an unusually large capacity in proportion to the heating surface, and provision is made for producing a large volume of steam on light grades for use on the heavy grades, when the tax on such light locomotives is always severe. Moreover, the locomotive is designed to run for some distance without firing, thus securing the advantages of the fireless system. The first consideration was also an important factor in the design of the novel locomotives for the Eastern Railroad of France, which were recently illustrated and described in these columns, and much resemble the present locomotive as regards the boilers.

The cut gives the leading features of this system as applied to a locomotive with 6-coupled wheels, now in service. The supplementary boiler is at *R*, communicating with the main boiler through the orifices *T T*. The steam passes from the dome through the pipe *C* to the "regulator" *D*, where it is reduced to the working pressure. Thence it passes through the tubes *G* to the valve at *H*, by which it is admitted to the cylinders. The exhaust steam from the cylinders passes to the box *K*, and from there through the pipe *L* on the stack itself to the air, according to the requirements for a suitable draft.

When the locomotive is working without firing, the different parts of the exhaust apparatus are in the positions indicated in the figure, the steam passing through the annular orifice *O* into the box K^1 and thence through the pipe *L*. When, on the contrary, the usual firing occurs, it is only necessary to lower the tube *L* by means of a lever, the position of which is indicated at *N*, and to raise the hoods at *M*, thereby causing the steam to escape into the smoke box and blow the fires.



A French Suburban Locomotive.

This system has been adopted for trial on some heavy locomotives of the Northern Railroad of France for service on the divisions entering Paris, where it is necessary to work with as little smoke as possible.

TECHNICAL.

Manufacturing and Business.

The Seybold Machine Co., of Cincinnati, has purchased from Carnegie, Phipps & Co., the Columbia Bridge Works, located at Dayton, O., and will at once improve the property and equip it with new machinery.

The National Paint Works of Williamsport, Pa., have secured the contract for furnishing the paint for the iron work for five out of the 13 buildings of the Columbian Exposition of Chicago. They are the Machinery Hall, Mines and Mining, Horticultural Hall and Fisheries Buildings. This is one of the largest paint contracts that has been let this year.

Mr. Charles P. Pollak has been appointed Manager of the Chicago office of the Ranken & Fritsch Foundry & Iron Co., of St. Louis, which has recently been opened at No. 407 Rookery Building. The company manufactures Corliss, piston and slide valve engines, steam and hydraulic elevators, and general machinery.

The Jones Bros. Electric Co., of Cincinnati, has a contract to build a complete model of the plant of the H. C. Fuch Coke Co. at Scottdale, which will be exhibited at the World's Fair. The estimated cost of the model of the coke plant is between $3,000 and $4,000. The model will occupy a space about 20 × 50 ft., made on a scale of one-twentieth of an inch to the foot, and will be an exact fac-simile of the original plant, including boilers, engines, elevated tracks, cupolas, cars and all other machinery, and will be in operation. The motive power, however, will be electricity.

New Stations and Shops.

General Manager Doddridge, of the St. Louis Southwestern, has agreed to build car shops at Pine Rock, Ark., if that town raises a bonus of $25,000.

W. R. Haven, who has the contract for building the new locomotive and car building shops for the New York Central at the new town of Depew, near Buffalo, has begun work on the foundations for several of the buildings. He expects to have 500 men employed in a few days.

In connection with our statement last week, with regard to work placed under contract by the Illinois Central we should have stated that the contract for the structural iron and steel work in the new Chicago station train shed has been placed with the King Bridge Co., of Cleveland, Chicago office, 1105 The Rookery.

Falls Hollow Staybolt Iron.

Professor J. B. Johnson, of Washington University has made a test of a sample of the Falls Hollow Staybolt Company's staybolt iron taken from regular stock, finding its elastic limit to be 28,300 lbs. per square inch, and its breaking strength 49,200 lbs. per square inch. He adds: "This is a remarkably fine specimen of wrought iron for staybolt purposes. Its elongation, 34 per cent., is the greatest I have ever found for wrought iron, and this is of the utmost importance in staybolt iron. The fracture shows a pure, fibrous, unlaminated and uncrystaline structure."

Power House for the Newport News Shipyard.

The new power house for the Newport News Shipbuilding & Dry Dock Co., of Newport News, Va., will be designed and built by The Berlin Iron Bridge Co., of East Berlin, Conn. In order to have the building absolutely fireproof no wood-work will be used in its construction, as the side walls will be of brick, the floors of iron and concrete, and the roof will be made with an iron frame covered with the Berlin Iron Bridge Co.'s patent corrugated iron covering. The steam, compressed air, hot air and electric light plant for the entire shipyard is concentrated in this one building.

International Railroad Congress.

We announced last week that the St. Petersburgh meeting of this congress will be held Aug. 20-Sept. 3. Since the first congress, at Brussels, in 1885, the importance of the meetings has become generally recognized, and there are now 32 governments and 244 different railroad companies actively interested in them. Only a few of the delegates to the coming congress have thus far been made known. France has appointed M. Picard, who presided at the sessions of the Paris congress, and Messrs. Gay, Metzger, Worms de Romilly and de Noir carmes; Austria will be represented by Mr. de Wittek, Inspector-in-Chief of the Austrian railroads, and by Mr. Max de Leber; Hungary will send Mr. de Ludwig, General Manager of the state railroads, and Japan will have as its representative M. O. Taizo, of the Japanese legation at St. Petersburgh. China also will be represented at tha congress, but delegates have not yet been named.

A Great Artificial Reservoir.

A company has been organized at Phœnix, Ariz., for the construction of a large artificial reservoir at Box Cañon, just below the junction of Tonto Creek and Salt River. The height of the dam will be 200 ft., and the water will extend back 16 miles, making the capacity 103,058,040,800 cu. ft. There is an abundance of lime rock timber and other building material on the ground, and the cost of the work is not expected to exceed $1,500,000.

The "Alley" Elevated in Chicago.

On Friday, May 20, a train of two cars and an engine was run over the line of the "Alley" Elevated road in Chicago to determine that all clearances of buildings and trees were sufficient. On Friday, the 27th, there will be run a special train to take the members of the City Council over the line. Saturday, the 28th, will be ladies' day. From that date until June 6 dummy trains will be run, to break in the train men. Monday, June 6, the line will be opened to the public, and trains will be run on schedule time.

Rolling Stock of the Paris, Lyons & Mediterranean Railroad.

In the report of this company, presented at the meeting of April 28, the following information was given concerning its new rolling stock: The construction of 10 high speed locomotives has been begun in the company's shops, and 90 compound freight locomotives, with four cylinders, have been ordered at various outside works. Anticipating the increased traffic that will follow the reduction of fares on fast trains, 516 passenger cars and 100 baggage cars have been ordered. Although the increased movement of passengers will be chiefly in the second and third classes, the new vehicles are entirely of the first and second, it being the intention to transform old vehicles of the higher classes for use in the lower classes. The greater part of the new cars will have compartments with two seats in each, with a lateral passage-way, and will be vestibuled to permit free communication through the length of the train, with a special view of making use of a dining car. The rolling stock of the company on the first of last January comprised 2,443 locomotives, 5,314 carriages and 87,297 freight cars.

Mannesmann Tube Rails.

The manufacture of rails by the Mannesmann process is, according to the *Revue Industrielle*, about to be made the subject of a new patent. As may be inferred, the chief feature of the rails to be made by this method will be found in the circumstance that they will be hollow. It is proposed, however, to fill the space formed with sand or any silicious powder before the rails are quite finished, and in the final passes it is expected that the heat from the hot metal, together with the applied pressure will have the effect of forming, inside of the rail, a solid block of silica. For the rails so made a greater resistance is claimed than that of rails of the same weight of metal made in the ordinary way.

Electric Transmission of Power.

The efficiency of the electric transmission plant, Lauffen-Frankfort, in Germany, has been placed at 75 per cent. by Dr. von Dolivo-Debrowolski, the Chief Engineer of the Allgemeine Elektricitäts Gesellschaft, of Berlin According to a report recently issued by him the losses are distributed about as follows: Dynamos, 8 per cent. transformers at Lauffen and at Frankfort, from 2.3 to 4 per cent.; transmission mains, from 10 to 11 per cent.

Duluth-Superior Electric Line.

A proposition is now under consideration for connecting Duluth and West Superior by means of an electric railroad. It is proposed to bridge the channel between Rice's Point, Duluth and Connor's Point, West Superior, and to cross this bridge with the line. There is considerable opposition to the plan from vessel owners and others interested in shipping.

The Long Locomotive Run.

We stated last week that the Pennsylvania had run a freight train through from Chicago to Philadelphia without change of engine. The locomotive which hauled the train is a class "R" engine built at Ft. Wayne shops. It is equipped with shaking grates standard on the Pennsylvania lines. Very little difficulty was experienced on the western line in keeping the fire clean This was done while taking coal and water; the engine was not detached from the train; only a few clinkers had to be removed. The fire was kept clean enough to answer every purpose by shaking the grates. The performance of the engine, in so far as we have heard, was entirely satisfactory.

Electric Lights for the World's Fair.

The Westinghouse Electric & Manufacturing Co. has been awarded the contract for the incandescent electric lighting plant at Jackson Park. The contract calls for 92,022 lamps, alternating current, for $399,000, under a bond of $1,000,000. The company is given until June 10 to file its bond and close the contract. Other large companies had pooled their interests and made a bid much higher than this, but, after long negotiation, Mr. Westinghouse persuaded the directors to advertise for new bids. The attorney of the Board of Directors told the Committee on Grounds and Buildings that it would be safe to accept the Westinghouse bid, notwithstanding the Edison injunction suit pending against the company. Mr. Westinghouse proposes to furnish ten or twelve dynamos of 12,000 lamp capacity. He says the company has about 100,000 lamps in stock, and that it can supply the material as called for by the contract. Ten thousand lamps will have to be in place by October 1 next.

Lake Street Elevated Railroad, Chicago.

Work was resumed on the Lake Street Elevated Railroad in Chicago on Monday. Material is beginning to arrive and will be put into position at once. It is intended to complete the main line. No work has been done on this structure for two years.

THE SCRAP HEAP.

Notes.

The first train of the season on the Manitou & Pike's Peak Railroad was run May 19, but it only went half way up.

A number of residents of West Philadelphia are making loud complaints of the smoke nuisance caused by the switching engines of the Pennsylvania road.

The fourth Vice-President of the Philadelphia & Reading took a party of about 40 New York and Philadelphia newspaper men on a three days' excursion to Gettysburg last week.

A fire in Oswego, N. Y., on the night of May 20, destroyed half a dozen grain elevators, the total loss amounting to half a million dollars. Only one elevator is left in the city.

Oliver C. Perry, the desperado who tried to rob an express car on the New York Central several weeks ago, was convicted at Lyons, N. Y., on May 18, and sentenced to 49¼ years' imprisonment.

It appears that Alphonse Vouillaire, the prisoner in a New York jail referred to last week, who had furnished stolen railroad documents to the Chicago *Tribune*, was never employed by the Interstate Commerce Commission.

The time of train No. 4 between Ogden and Denver over the Rio Grande Western, the Colorado Midland and the Atchison, Topeka & Santa Fe, has been shortened 5¾ hours, the new time table going into effect last Sunday. The connections are such that practically 12 hours is saved between Ogden and Chicago.

On the morning of May 21, four robbers attacked a train of the Jacksonville, Tampa & Key West near Munro Junction, Fla., and killed the express messenger. Another man in the car was wounded by a pistol shot, but he and others made such stout resistance that the robbers became alarmed and fled without any booty. Large searching parties were organized by the sheriff, and on the 25th two fugitives, reported to be two of the robbers, were killed. Seven other men have been arrested on suspicion.

The annual meeting of the Brotherhood of Locomotive Engineers has re-elected Mr. P. M. Arthur Grand Chief Engineer for four years. Mr. Arthur desired to retire, hav

ing served 18 years, but the convention insisted upon his taking another term. He will be granted leave of absence to visit his native country, Scotland. The next convention will be held in May, 1894, biennial meetings being substituted for annual.

The Kansas Board of Railroad Assessors has reduced the total assessments on railroad property of the state about $7,000,000 from last year. There has been considerable criticism of this action, and one of the assessors, replying, says that strife between assessors of different counties in past years has resulted in an unfair reduction of the valuation of other property, thus leaving the railroad taxes higher in proportion than they ought to be.

A number of representatives of railroad employes' clubs met at Omaha May 17 and formed a national organization, the President being W. L. Steadman, of Iowa, and the Secretary W. E. Perry, of Minnesota. The constituencies seem to be principally in these states and in Nebraska and Kansas. The nature of the organization seems to be political. It will be remembered that a number of clubs of this kind have existed in Minnesota for a year or two past.

Spanish American Notes.

The contract for the sale of the Rio Claro Railroad, Brazil, to the Companhia Paulista, has been signed.

The Brazilian government has annulled the grant for the Benevente & Minas Railroad which had been made to the ill-fated Companhia Geral de Estradas de Ferro.

The Brazilian Minister of Agriculture has decided against the petition of the Sao Paulo Railroad to exclude the Sorocabana Railroad from extending its line to Santos.

The rolling stock of the Andine Railroad, Argentine is in so deplorable a condition that the National Railroad Board has memorialized the government upon the necessity of its improvement. It has also recommended that the Banco de la Nacion be authorized to advance funds to the Andine Railroad with which to purchase materials.

The Central Railroad in Brazil has been so notoriously mismanaged that the government has brought pressure to bear which will result in the construction of new sidings, new warehouses, general repairs upon the line, and an extra track between Rio and Cachoeira, between Barra and Porto Novo, and between Entre Rios and Serraria. A large number of new freight cars are also to be ordered.

It is reported that the Brazilian government has determined to appropriate the sum of of 2,400,000 mil reis for the construction of the long discussed telegraph line from Pará to Manáos, at the head of steamship navigation on the Amazon. There is now a monthly line of steamships plying between New York and Manáos, and upon the completion of the telegraph line to that city there may be business enough to warrant an additional line of steamers.

One of the most important enterprises in South America was completed by the opening of the final section of the Antofagasta & Bolivia Railway to the city of Oruro, on May 8. The richest portion of the great Bolivian plateau now enjoys easy communication with the Pacific. The city of Oruro lies only a short distance south of the Bolivian capital, La Paz, between which places a railroad is contemplated, the concession for which is to be disposed of to the highest bidder this summer.

A new line of steamers has been started between England and Peru by the firm of Lamport & Holt. A comparison of freight rates reveals one cause of our difficulty in competing for South American trade, as, for example, the charge from Payta, Peru, to New York, is $28 per ton, and from Payta to Liverpool only $12; from Callao to New York $20, and to European ports only $5. There are two German, three English and two French lines of steamships plying between the "West Coast" and Europe, and none as yet between there and the United States.

The Cauca Railroad, in Colombia, from Buenaventura to Cali, will soon be completed. Mr. James C. Cherry, of Chicago, the concessionaire of this road, sailed from Panama for Buenaventura on May 10, accompanied by four engineers, who will take charge of the several sections and hasten the work of construction as rapidly as possible. Twenty-two miles of the road are in actual operation, and 34 miles have been graded ready for laying the rails. Difficulty has been experienced in procuring labor, although not less than 350 men have been continuously employed during the last season, and at one time 800 men were engaged on the work. The wharf at Buenaventura is to be rebuilt this summer, and extended so as to furnish 30 ft. of water to vessels visiting that port. The machine shop at that place is also to be refitted and prepared for handling the increased rolling stock demanded by the road. A contract has been let for supplying 10 new locomotives in addition to the five now on hand, and a number of freight cars, flats, etc., are to be ordered shortly. An electric light plant has been ordered for Buenaventura, and also an electric drilling plant, with 40 machine drills, for the heavy rock work on the line. Two steel bridges are to be erected, one of 200-ft. span across the Rio Dagua at San Cipriano, and another of 180-ft. span at Sucre. A telephone line is also to be put up in addition to the telegraph line operated by the government.

World's Fair Notes.

Drawings are being made for a large temporary amusement hall with a capacity for seating 15,000 to 20,000 people. It will be 200 × 230 ft., three stories high, estimated cost $40,000.

The work on the Machinery building has progressed rapidly; within two months from the time the floor was laid it has been sufficiently far advanced to place the heavy supports for the main shafting.

The crowds visiting the fair grounds are so great that the authorities are considering some means to stop the flow. The 25-cent admission rate does not act in the way expected, for a glance at the entrance gates would lead one to believe that the fair was already in progress.

Work on several of the State buildings has been started in the improved portion of the park. The Government building and the battle ship are progressing slowly. The route for the elevated railroad has been surveyed and construction will be commenced at once.

It seems improbable that the great Manufacturers' building will be completed with the others for the dedication in October. It has taken one month to erect four of the nineteen iron trusses. The strike of the iron workers has delayed matters considerably. The force must necessarily be increased if this structure is turned over with the remainder in October.

"Privacy" in "Railway Carriages."

Hon. Patrick Greville-Nugent, who was indicted for having attacked Miss Marion S. Price in a compartment of a railway carriage, pleaded guilty, in the North London Sessions, on May 12, of common assault. He was sentenced to six months' imprisonment at hard labor. The convicted man is 40 years old, a Deputy Lieutenant and a magistrate of County Westmeath, Ireland, and held a high social position. He pleaded, in the extenuation of his offense, that he was drunk at the time.

Miss Hannah Cordock, a young woman of good family, was assaulted May 12 by Albert Windle, in a compartment of a train on the Manchester, Sheffield & Lincolnshire Railway.

May 17 one Kennedy Bell, a clergyman of the Church of England, was arrested for assaulting two girls in a railway carriage during one journey. He had the evil fortune to find each one alone at different times.

We do not know whether these affairs have been more than usually common lately or whether the trans-Atlantic purveyors of filth to the American press have been unusually active.

The Calumet Canal.

The Calumet Canal & Improvement Co. held its stockholders' meetings May 3. General Torrence having disposed of his interest in the company to New York and Chicago capitalists, a considerable change was made in the directory. Robert E. Tod, President; Emmons Blaine, Vice-President; John G. Watson, Secretary and Treasurer. Owen F. Aldis, Emmons Blaine, John G. Watson, Chicago; James C. Parrish, New York, John Kean, Jr., of Elizabeth, N. J., are added to the Board of Directors. Executive Committee: Robert E. Tod, Owen F. Aldis, Emmons Blaine and A. S. Northcote.

The Railroad to Jerusalem.

Jerusalem is to be reached by rail by the end of this year, if the French company which is constructing the line meets with no accident. At the beginning of this year 28 miles were open for traffic, leaving 22 miles to be completed. Pilgrims will find this not the straight way, perhaps, but at least the narrow one (metre gauge) to the Holy City.

Steel Making in India.

A small open-hearth steel plant has been established by the Indian government near Calcutta. The purpose is to use the native ores and steel scrap, of which a good deal is to be had, and to make steel castings and forgings and light rolled sections. The plant includes a three-ton furnace, with gas producers, core ovens and annealing furnaces. Men have been sent to England for instruction in open-hearth working. This plant has been established with particular reference to the importance of having a local factory for shells and other war material.

A Good Run.

The Columbian express on the Pennsylvania recently made an excellent run between Ft. Wayne and Chicago. The train was running two hours late at Ft. Wayne. It was composed of engine 147, baggage car, two coaches, dining car and two Pullman, all vestibuled. It made the run to Chicago, 148 miles, in 3 hours, 3 minutes, making two stops for water, and running slowly through the Chicago yards; making up one hour and twelve minutes on the running schedule. The rate including stops was 49 miles an hour.

Strict Discipline.

The following item calls to mind the Texas man's opinion about the utility of a pistol. He didn't need a weapon very often, but when he did want one he "wanted it like h——l." Passenger cars do not often have to be set out for dangerous defects, but when there is such a case the need of detecting the danger is of the highest importance.

"One day last week while a sleeping car belonging to Erie train No. 12 was being switched at Corning, the car got away from the engine and smashed into the train, wrecking the drawheads and airbrakes and moving the trucks beneath the sleeper about 3½ in. out of their proper places. This latter defect was not discovered, however, until the train reached Jersey City the next morning. The train had traveled in imminent danger of a serious accident at any time. . . . The two car inspectors in this city whose duty it was to examine the trucks as well as the car inspectors at every other station between here and New York where the trucks should have been examined, have been discharged."—*Elmira (N. Y.) Advertiser.*

Passenger Blown From a Train.

James Malloy, a passenger on a Chicago, Milwaukee & St. Paul train, running 45 miles an hour, attempted to pass from the smoker into a rear coach near Mason City, Ia., on May 19, and in doing so was blown from the platform into the ditch. He was fatally injured.

Vestibuled cars are advertised as a prominent feature on the Milwaukee road, but probably this was one of the trains that do not afford that luxury. In fact, a train making frequent stops is better off without vestibules than with them, as the necessarily narrow doorways greatly impede the passengers when there are a number to get in or out at once. But platform *gates* are practicable on any modern car, and they are so simple and useful that every car should have them. They will not stop a person who is determined to jump off and kill himself, but they afford a good warning to the careless.

New Loop for the Chicago City Railway Wabash Avenue Line.

The Chicago City Railway (Cable) is building a new loop on Michigan avenue to relieve the loop now used by the Wabash avenue and State street lines. It is expected that the new loop will be completed in three weeks. A new cable track will be put in west of the track already in on Wabash avenue, so that the old track can be used for the new loop and the new track used for the old. When the new work is completed the two lines will run as follows: State street cars leave State street, go east to Madison to Wabash, north on the new track to Lake, west on Lake to State. The Wabash avenue cars will go east on Madison to Michigan avenue, north on Michigan avenue to Randolph, west on Randolph to Wabash avenue, and south on Wabash to Madison on the east track when it connects with the old system. This makes the two lines independent of one another and will relieve the congestion that occurs daily on the Lake street and State street part of the old loop during the morning and evening rush.

Railroads in Belgium.

According to the official railroad statistics of Belgium, the government roads of that country had in use in 1890, 1,977 locomotives, 4,825 passenger cars, and 42,572 freight cars; 64,288,892 passengers, and 26,859,470 tons of freight were carried during the year. The total length of the lines was 3,249.96 kilometres or about 2,018 miles. The total length of the several lines under private control, on the other hand, was 1,477.94 kilometres(about 918 miles). The number of locomotives on these lines was 535; street car engines, 10; passenger cars, 827; freight and baggage cars, 13,766. The number of passengers carried was 18,160,376; and the tons of freight, 16,175,816.

New South Wales.

The political character of the proceedings against the Railroad Commissioners of New South Wales is more apparent the more facts we get. A correspondent says, speaking of Mr. Eddy, "all the reputable papers here, the two dailies, the evening papers and the three principal weekly illustrated, strongly support his skillful and non-political management, that has rescued the lines from a state of chaos, and while greatly augmenting comfort and speed of travel has largely reduced working expenses and augmented the profits, so that the lines now nearly pay full interest on their cost of construction. The money was borrowed at about 4 per cent., and the lines now pay 3.6 per cent. As the Commissioners have spent large sums in improving rolling stock, permanent way, stations, duplication, improvement of grades and curves, signals, extension of bicok working, etc., this is an excellent result to achieve in three years."

Heavy Timber Contracts.

Messrs. Grant & Foley, of St. Paul (Donald Grant and Foley Brothers & Guthrie) have a number of contracts which require the handling of an immense amount of lumber. The ore docks for the Duluth & Winnipeg, in addition to 2,800 pieces of piling, will consume 2,000,000 ft; The Superior Belt & Terminal Road 2,300,000 ft., Duluth Terminal 2,000,000 ft., and the 16 mile branch of the Duluth, Messabe & Northern, to the Biwabik mine, about 2,200,000 ft. more. All of this work is to be completed before July 15.

Northern Pacific Railroad Steamers.

The Northern Pacific Railroad Company has secured the establishment of an additional line of steamers between the Pacific coast (Tacoma) and China and Japan. After long negotiations an arrangement has been made with an English syndicate by which a new company called the Northern Pacific Steamship Company has been formed, with Sir William G. Pearce, of London, as President. The ships are the "Parthia," the "Batavia," and the "Abyssinia," built in 1870. They have seen service in the Cunard and Guion lines and were used by the Canadian Pacific on the Pacific Ocean before the present boats of that line were built. The new line will fly the British flag. Trips will be made monthly in each direction. The line has been established in season to carry a part of the tea crop this year. The Northern Pacific road has heretofore carried about 25 per cent. of the tea crop of China and Japan, the tea coming in sailing vessels, but the service has been very unsatisfactory. The first steamer of the new company left Hong Kong on May 21. The Northern Pacific Railroad Company has no pecuniary interest in the ships, and it is said that it does not take any risk in the operation of the line. This makes the fourth trans-Pacific line, the others being the Pacific Mail, the Canadian Pacific and the Oriental & Occidental. Each company has three vessels, except the Pacific Mail, which has four.

LOCOMOTIVE BUILDING.

The Duluth & Winnipeg has ordered two freight engines from the Baldwin Locomotive Works.

A heavy eight-wheel engine is being built at the shops of the International & Great Northern, at Palestine, Tex., from designs by the Master Mechanic, F. Hufsmith.

The Toledo, Ann Arbor & North Michigan will soon purchase 15 or 20 new locomotives; the number has not yet been decided, and the order will probably not be given out before the fall.

CAR BUILDING.

The Jackson & Sharp Co. is building a number of parlor cars for the Boston & Maine.

The Delaware & Hudson Canal Co. is having passenger cars built by the Gilbert Manufacturing Co., of Troy, N. Y.

The Toledo, Ann Arbor & North Michigan will probably soon be in the market for about 1,000 miscellaneous freight cars, but principally box cars, for delivery during the fall.

The Chicago, Burlington & Quincy has contracted for 49 passenger cars with the Jackson & Sharp Co., of Wilmington, Del. Bids for 50 new chair cars are in, but the contracts have not been awarded.

BRIDGE BUILDING.

Corpus Christi, Tex.—The bill authorizing the Aransas Harbor Terminal Railway Co. to construct a bridge over the Corpus Christi Channel, known as the Morris & Cummings Ship Channel, in Aransas County, Tex., was passed by the United States Senate on May 11.

Dahlonega, Ga.—Bids are being received by the boards of roads and revenue at Dahlonega, for the erection of a bridge near Leather Ford, in Lumpkin County, Ga.

Denison, Tex.—The County Commissioners have let the contract for the construction of four iron bridges.

Grafton, W. Va.—The Baltimore & Ohio is building a double-track steel truss bridge over Three Fork River at Grafton, W. Va., to afford more convenient connection between the main line and the Grafton & Greenbrier.

Martinsburg, N. Y.—At a special town meeting to vote upon the proposition to build an iron bridge over the creek on Main street in this village, a majority of votes were cast in favor of an iron bridge.

New Brunswick, N. J.—The Pencoyd Iron Co., of Philadelphia, is reported to have received a contract for erecting the iron bridge across the Raritan River for the

Pennsylvania. Shanley Bros., of Newark, are the contractors for the stone work.

New York City.—The Committee on Commerce of the Senate has reported back adversely the bill to authorize the New York & New Jersey Bridge Co. to construct a bridge across the Hudson River between New Jersey and New York, and it has been placed on the calendar.

Pottsville, Pa.—A new bridge across the river to connect Pottsville and Palo Alto, and to cost $30,000, will be built by the Philadelphia & Reading, the Electric Railroad and Palo Alto borough.

Pittsburgh.—A proposal to erect two free bridges across the Monongahela River, at Pittsburgh, to connect with the south side of the city is being agitated. It is suggested that one bridge might be built by the city of Pittsburgh, and a second by the county.

Riverton, Va.—Bids are being received by Samuel Carson, at Riverton, for the stone work and superstructure of two iron bridges across the Shenandoah River.

Simsbury, Conn.—At a special town meeting, last week, the selectmen were directed to cause a new bridge to be erected over the Farmington River, at a point near the present bridge.

Sioux City, Ia.—Sioux City is interested in a bill now before Congress granting a charter to the Interstate Bridge Co., to build a wagon bridge across the Missouri River. The bridge will begin at the foot of Nebraska street, in Sioux City, to South Sioux City, Neb. Henry T. Oxnard, of Sioux City, is President of the company, and it is reported that J. A. L. Waddell, of Kansas City, is to be the engineer of the company.

Toledo, O.—Specifications have been completed by Superintendent of Bridges Reed, of the Lake Shore & Michigan Southern Railroad for an iron bridge at the Broadway street crossing in Toledo. It will have a wagon way and footwalks.

West Fairview, Pa.—A new iron bridge across the Susquehanna River to connect West Harrisburg with West Fairview will be built by capitalists of the latter town at a cost of $125,000.

MEETINGS AND ANNOUNCEMENTS.

Dividends.

Dividends on the capital stocks of railroad companies have been declared as follows:

Catawissa, semi-annual, 3½ per cent., on the preferred stock, payable on demand.

Stockholders' Meetings.

Meetings of the stockholders of railroad companies will be held as follows:

Canada Southern, annual, New York City, N. Y., June 1.

Chicago, Burlington & Northern, annual, La Crosse, Wis., June 8.

Chicago & Eastern Illinois, annual, Chicago, Ill., June 1.

Chicago & Northwestern, annual, Chicago, Ill., June 2.

Chicago, St. Paul, Minneapolis & Omaha, annual, Hudson, Wis., June 4.

Colorado, annual, Denver, Col., June 1.

Des Moines & Fort Dodge, annual, Des Moines, Ia., June 2.

Hudson Susp. Bridge & New England, annual, New York, N. Y., June 6.

International & Great Northern, special, Palestine, Tex., July 14.

Keokuk & Des Moines, annual, Des Moines, Ia., June 1.

Mexican Northern, annual, New York, N. Y., May 27.

Milwaukee, Lake Shore & Western, annual, Milwaukee, Wis., June 3.

Minneapolis, St. Paul & Sault Ste. Marie, annual, Minneapolis, Minn., June 7.

Minnesota Transfer, annual, St. Paul, Minn., June 8.

New York & New England, annual adjourned, Boston, Mass., May 31.

New York & South Beach, annual, New York, N. Y., June 7.

Paducah, Tennessee & Alabama, special, Puducah, Ky., June 15.

St. Joseph & Grand Island, annual, Elwood, Kan., June 14.

St. Louis, Alton & Terre Haute, annual, St. Louis, Mo., June 6.

St. Louis, Iron Mountain & Southern, special, St. Louis, Mo., May 27.

St. Paul & Northern Pacific, annual, New York City, N. Y., June 1.

St. Paul & Sioux City, annual, St. Paul, Minn., June 4.

Superior Short Pine, annual, St. Paul, Minn., June 6.

Vermont & Massachusetts, annual, Boston, Mass., June 1.

Technical Meetings.

Meetings and conventions of railroad associations and technical societies will be held as follows:

The *American Institute of Electrical Engineers* will hold its next annual meeting at the Grand Pacific Hotel, Chicago, Ill., June 6, 7 and 8.

The *American Society of Civil Engineers* will hold its next annual convention at the Hygeia Hotel, Old Point Comfort, Va., June 8.

The *Master Car Builders' Association* will hold its annual convention at Congress Hall, Saratoga Springs, N. Y., June 15.

The *American Railway Master Mechanics' Association* will hold its annual convention at Congress Hall, Saratoga Springs, June 20.

The *American Association of General Baggage Agents* will hold its next annual meeting at Mackinac Island, Mich., July 20.

The *New England Railroad Club* holds regular meetings, at the United States Hotel, Beach street, Boston Mass., on the second Monday of each alternate month, commencing January.

The *Western Railway Club* holds regular meetings on the third Tuesday in each month, except June, July and August, at the rooms of the Central Traffic Association in the Rookery Building, Chicago, at 2 p. m.

The *New York Railroad Club* holds regular meetings on the third Thursday in each month, at the rooms of the American Society of Mechanical Engineers, 12 West Thirty-first street, New York City, N. Y.

The *Southern Railway Club* holds regular meetings on the third Thursday of the months of January, February, March, May, September and November at such points as are selected at each meeting.

The *Central Railway Club* meets at the Hotel Iroquois, Buffalo, the fourth Wednesday of January, March, May, September and November. By special resolution the next meeting will be held in April.

The *Northwest Railroad Club* meets on the first Saturday of each month, except June, July and August, in the St. Paul Union Station, at 7:30 p. m.

The *Northwestern Track and Bridge Association* meets on the Friday following the second Wednesday of March, June, September and December, at 2:30 p. m. in the directors' room of the St. Paul Union Station.

The *American Society of Civil Engineers* holds its regular meetings on the first and third Wednesday in each month, at the House of the Society, 127 East Twenty-third street, New York.

The *Boston Society of Civil Engineers* holds its regular meetings at the American House, Boston, at 7:30 p. m., on the third Wednesday in each month.

The *Western Society of Engineers* holds its regular meetings at 78 La Salle street, Chicago, at 8 p. m., on the first Wednesday in each month.

The *Engineers' Club of St. Louis* holds regular meetings in the club's room, Laclede Building, corner Fourth and Olive streets, St. Louis, on the first and third Wednesday in each month.

The *Engineers' Club of Philadelphia* holds regular meetings at the House of the Club, 1,122 Girard street, Philadelphia, on the first and third Saturday of each month. The annual meeting is held on the third Saturday in January. The club stands adjourned during the months of July, August and September.

The *Engineers' Society of Western Pennsylvania* holds regular meetings on the third Tuesday in each month, at 7:30 p. m., at its rooms in the Thaw Mansion, Fifth street, Pittsburgh, Pa.

The *Engineers' Club of Cincinnati* holds its regular meetings at 8 p. m. on the third Thursday of each month in the rooms of the Literary Club, No. 24 West Fourth street, Cincinnati.

The *Civil Engineers' Club of Cleveland* holds regular meetings on the second Tuesday of each month, at 8 p. m., in the Case Library Building, Cleveland. Semi-monthly meetings are held on the fourth Tuesday of the month.

The *Engineers' Club of Kansas City* meets in Room 200, Baird Building, Kansas City, Mo., on the second Monday in each month.

The *Engineering Association of the South* holds its monthly meetings on the second Thursday at 8 p. m. The Association headquarters are at Nos. 63 and 64 Baxter Court, Nashville, Tenn.

The *Denver Society of Civil Engineers and Architects* holds regular meetings at 36 Jacobson Block, Denver, Col., on the second and fourth Tuesday of each month, at 8 o'clock p. m., except during June, July and August, when they are held on the second Tuesday only.

The *Civil Engineers' Society of St. Paul* meets at St. Paul, Minn., on the first Monday in each month.

The *Montana Society of Civil Engineers* meets at Helena, Mont., at 7:30 p. m., on the third Saturday in each month.

The *Civil Engineers' Association of Kansas* holds regular meetings at Wichita on the second Wednesday of each month at 7:30 p. m.

The *American Society of Swedish Engineers* holds meetings at the club house, 250 Union street, Brooklyn, N. Y., and at 347 North Ninth street, Philadelphia, on the first Saturday of each month.

The *Engineers' Club of Minneapolis* meets the first Thursday of each month in the Public Library Building, Minneapolis, Minn.

The *Canadian Society of Civil Engineers* holds regular meetings at its rooms, 112 Mansfield street, Montreal, P. Que., every alternate Thursday except during the months of June, July, August and September.

The *Association of Civil Engineers of Dallas* meets at 803 Commerce street, Dallas, Tex., on the first Friday of each month at 4 o'clock p. m.

The *Technical Society of the Pacific Coast* holds regular meetings at its rooms in the Academy of Sciences Building, 819 Market street, San Francisco, Cal., at 8 o'clock p. m. on the first Friday of each month.

The *Tacoma Society of Civil Engineers and Architects* holds regular meetings on the third Friday of each month, in its rooms, 201 and 202 Washington Building, Tacoma, Wash.

The *Engineers and Architects' Club of Louisville* holds regular meetings on the second Thursday of each month, at 8 o'clock p. m., at its rooms in the Norton Building, Louisville, Ky.

The *Association of Engineers of Virginia* holds regular meetings at Roanoke, on the second Saturday in each month, at 8 p. m., except the months of July and August.

American Society of Civil Engineers.

The annual convention will be held at the Hygeia Hotel, Old Point Comfort (post-office address is Fortress Monroe, Va.), beginning on Wednesday, June 8, at 10:30 o'clock. The hotel rate has been fixed at $3.50 per day. The uniform rate for the round trip of one and one-third times one regular passenger fare to the place of meeting, has been granted from all points covered by the New York and Boston Lines Passenger Committee, the Trunk Line Association, the Southern Passenger Association and the Central Traffic Association.

If a sufficient number signify their intention of going over its lines, a special train will be furnished by the Pennsylvania Railroad Company over the Cape Charles Route, on Tuesday, June 7, arriving at Old Point at 7:10 p. m. The boats can be taken either at Desbrosses or Cortlandt streets, New York, at 8:45 a. m. A dining car will be attached for dinner. Members coming from the West are requested to concentrate at Cincinnati in time for the 6:10 p. m. train, on Monday, June 6, which leaves for the East over the Chesapeake and Ohio road; and will reach Old Point at 6:35 the next evening. The officers of this road promise special arrangements on this train, and should the number be large enough to warrant it, a special train will be run.

The exact details of the programme cannot be given until a later date. On Saturday morning, June 11, through the courtesy of Mr. C. B. Orcutt, President of the Newport News Dry Dock and Ship Building Company, the Society will visit these works, at which time it is anticipated that an iron steamer, the El Norte, of about 4,000 tons burden will be launched. Sister ships, one nearly ready for sailing, and one still in skeleton form, can also be examined.

The following papers have been thus far received. As fast as they can be put in type advance copies will be sent to those wishing to discuss them: "Uniform Practice in Pile Driving," by J. Foster Crowell; "Rainfall, Flow of Streams and Storage," by Desmond Fitzgerald; "Black Eagle Falls Dam," by M. T. Parker; "Hardening Structural Steel," by A. M. Cunningham; "Tests of Full Sized Eye-bars," by F. H. Lewis; "The Cantilever Highway Bridge at Cincinnati," by Gustave Kaufman; "The Cantilever Span of the Same," by F. C. Osborn; "Bridging Cañons Lengthwise," by H. V. Hinckley; "Experiments on Iron and Steel Joints," by B. P. Flint; "Railroad Emergencies," by Channing M. Bolton.

Papers are promised as follows: "The Increasing Cost of Railway Tie Renewals," by Benjamin Reece; "Construction and Cost of the B. & O. R. R. Tunnel in Philadelphia," by W. W. Thayer; "Details of the New Government Pier at Old Point Comfort, Virginia," by John B. Duncklee.

Association of Engineers of Virginia.

The Directors of the Association decided at their meeting of May 21 to postpone the regular meeting which was to be held the latter part of May to July 4 and 5; the meeting will be held at Richmond, with headquarters at Ford's Hotel.

The following papers are known thus far to be under preparation for this meeting:

"An Address," by President Clarence Coleman; "Description of the Engines of the Battle Ship Texas," by E. T. D. Myers, Jr.; "An Engine and Boiler Test," by Prof. James H. Fitts; "Construction of Electric Dynamos," by Prof. W. E. Anderson; "The Northerly Point," by R. P. Crenshaw; "The Necessity of Co-operation of American Engineers," by T. W. N. Draper; "A Plea for the Establishment of a United States Weather and Signal Station at Roanoke, Va.," by Chas. S. Churchill; "A National Railroad College," by Herman Crueger; "Spiral Curves," by Chas. H. Rice; "River Improvements," by Prof. D. C. Humphreys. The headquarters of this Association are Roanoke, Va., and the Secretary is Mr. J. R. Schick.

Associaton of Railway Claim Agents.

The next meeting of the association will be held at the Hotel Cadillac, Detroit, Mich., Thursday, June 2, at 10 A. M. A cordial invitation is extended to all railroads to send representatives. R. C. Richards is President of the association, and F. Everest is Secretary and Treasurer.

Engineers' Club of St. Louis.

The club met May 18, President Johnson in the chair and 16 members present.

"STRESSES IN DRAW BRIDGES."

In the absence of the author, Mr. Turneaure read Prof. Howe's paper on the "Maximum Stresses in Draw Bridges." The paper discussed the various loadings possible for draw bridges, under different conditions; then took up the case of a draw bridge of two equal spans acting as a continuous girder and subjected to equal panel concentrations. The panel points which should be loaded to produce the maximum moment or shear at any point was found by the aid of a diagram having plotted on it curves giving position of zero moment, amount of moment at turntable support, and amount of end reaction, for a concentrated load at any point. Only four different loadings were found to be necessary, and knowing these four corresponding equilibrium polygons were sufficient to determine the maximum positive and negative shears at each panel point. The web stresses were determined by taking from the diagram the end reactions due to the panel loads applied in each case, and with the combined reaction compute the web stress as in a discontinuous space. For unequal concentrations the best method would probably be to compute the moments and shears for each panel for each load, and then distribute the concentrations as nearly as possible, according to the magnitude of these moments and shears. For actual wheel loads the computation would be very complex. Instead of wheel loads, an assumed equivalent uniform load or a uniform load and an engine excess would give stresses nearly correct. Discussion followed by Messrs. Johnson, Hubbard and Pegram.

Professor Johnson exhibited an apparatus designed by him and constructed by Maher & Co., St. Louis, for measuring the elongation or compression of test specimens while under stress. It consists of two collars fastened to the specimen by set screws, each carrying a graduated circle 4 in. in diameter, over the face of which moves a balanced pointer. This pointer carries a small vernier and is attached to a spindle, in which is a friction roller measuring exactly one-half inch in circumference. The roller on one spindle is operated by an arm which is attached to the other collar, these arms being mounted symmetrically on opposite sides of the specimen. The apparatus reads with exactness to the nearest one ten-thousandth of an inch, and registers elongations beyond the elastic limit as readily as it does those below that limit. Its operation is very satisfactory.

Northwestern Track and Bridge Association.

The next regular meeting will be held in the directors' room of the St. Paul Union Station on Saturday, June 11, at 2:30 p. m. The subjects continued from the last meeting will be discussed.

Northwest Railroad Club.

A meeting will be held on Friday May 28, at 2 p. m. in the directors' room of the St. Paul Union Station. Papers on the following subjects will be presented: "Car Heating," J. C. Barber, M. C. B., Northern Pacific, and J. C. Halliday of the Consolidated Car Heating Co.; "Brake Adjustment," John R. Church, of the American Brake Co.; "Electrical Appliances in Railway Shops," C. A. Seley, M. E. Changes in the Rules of Interchange will also be informally discussed and officers for the ensuing year will be elected.

The Engineers' Club of Philadelphia.

At the meeting of May 7, Mr. James Christie, President, was in the chair; about 50 persons present.

THE TROLLEY SYSTEM.

The discussion on the trolley system, continued from the meeting of April 16, was resumed.

Mr. Carl Hering presented the following statistics:

It is only seven years since the first electric railway was put into commercial operation in the United States. On Jan. 1, 1888, there were in operation only 48 miles of electric roads, while in 1891 there were 2,893. In September, 1891, the subdivision of the various street railways was as follows: 5,412 miles operated by animal power, 3,000 by electricity, 1,918 by steam and 600 by cable; 1,003 roads use animal, 412 electricity and 54 cable. The diminution in the number of horses in one year was 28,681. England has only 20 miles of electric railroads.

The number of passengers carried per year in Philadelphia is given as about 150,000,000, or over 100 rides per inhabitant, about the same ratio as in New York. Philadelphia has 510 miles of track, or, with the exception of Chicago, which has 452 miles, it has almost twice as many miles as any other city in the country.

Mr. C. Henry Roney read a paper descriptive of the experimental electric conduit system constructed and operated on Ridge avenue, Philadelphia, in 1885 and 1886.

Mr. Carl Hering sketched upon the board a cross-section of the conduit used in Buda Pesth. The conduit is

of concrete, with cast iron frames every three or four ft. The road is 10 or 15 miles long, and is the only electric conduit road now in successful commercial operation on a large scale.

Mr. FORD: Mr. Salom has stated that the life of an accumulator is about 6,000 car miles. Will he state what it costs at the end of that time to replace the plates?

Mr. SALOM: As stated in the October number of our proceedings, about $2.50 per element, or say $250 per car, or 4 cents per car mile.

As to the comparison between laboratory tests of storage batteries and the test in actual practice, I will say that the latter test is more severe than it ought to be, and more severe than it would be if the storage system had been exploited as industriously as the trolley system. There should be a resistance placed between the battery and the motor, to avoid the severe strain of starting.

Mr. T. CARPENTER SMITH: Rapid transit proper cannot be had on a surface road, and this, of course, applies to the trolley system. No surface road can be expected to handle more passengers than does our Market street cable road. It is not unusual there, at times of heavy traffic, to see three trains of three crowded cars each, in one block at the same time, and under these circumstances these trains do not stop to take in passengers, and still the cable road cannot handle the traffic between say 5 and 6.30 p. m. An elevated railroad train of three cars would carry as many passengers as these nine cable cars; it makes fewer stops and is not subject to delay at junctions, as are the cable cars at the crossings of Seventh and Ninth streets with Market street. The erection of a trolley system would be an effectual barrier to the erection of an elevated road. Market and Broad streets, owing to their width, are the streets that would suffer least from the trolley system, but all would unite in insisting that Broad street must be kept clear, and Market street could have no trolley because it already has the cable, which spoils the street worse than the trolley would do. During five or six years every wire put under ground was put there for the express purpose of showing that it could not be done. As soon as it came to be done by parties interested in having them there, it was seen that there was no difficulty about it. On the new underground electric light system in London, 10,000 volts (a pressure which was ridiculed until two years ago) have been used for several months at the Deptford Station. There has been but one breakdown, and that was owing to a fire not incident to the operation of the road. Both sets of mains (four wires) were melted down, and operations were stopped for six hours.

The Saratoga Conventions.

It has been agreed upon that the supply men meet on Tuesday evening, June 14, at Congress Hall Hotel, Saratoga Springs, and arrange their programme for the coming conventions. It is hoped there will be a large attendance.

PERSONAL.

—President Manvel, of the Atchison, Topeka & Santa Fe, arrived at New York last week after a two months' trip in Germany and Southern Europe.

—Mr. J. McFeggan, General Western Freight Agent of the New York Central & Hudson River road, with headquarters at Buffalo, resigned this week on account of ill health. He has been in the service of the company 35 years.

—Mr. W. D. Turner, General Manager of the works of the Eames Vacuum Brake Company and New York Air Brake Company, at Watertown, resigned his position, to take effect May 1. He will go abroad during the summer on business and for recreation.

—Mr. N. A. Harris, who has been elected President of the Macon & Southern by the Lessee Board, which is to operate the road for the joint account of the Richmond & Danville and Central of Georgia, has been connected with the company since its organization in 1885, when he was appointed counsel.

—Mr. M. L. Ansley, formerly Division Roadmaster of the Louisville & Nashville Railroad, died at his home at Ocean Springs, Miss., last week. Mr. Ansley some months ago resigned his position on the Louisville & Nashville, and has lately been President and General Manager of the Ocean Springs Lumber Co.

—Hon. Charles A. Broadwater, of Helena, Mont., died on May 24 of heart failure, a little over 60 years of age. He was a pioneer settler of the state, and was actively identified with the financial, commercial, railroad and political interests of that section. He was President of the Montana National Bank and President of the Montana Central road, which he built.

—Mr. J. Millard Fillmore, Manager of the Pacific Coast Railroad, died at San Luis Obispo, Cal., May 21. He has been manager of the company since 1882, and was previously superintendent of the Oregonian and of the Oregon Railway & Navigation Co. Between 1872 and 1888 he was Superintendent of the North Pacific Coast road.

—Messrs. Farwick, Schröder and Dr. Koch, officers of the Prussian State railroad system, are making a quick journey from New York to Chicago by Philadelphia, Altoona and Pittsburgh, and back by the New York Central. They came with letters from Mr. Von Borries, who is so pleasantly remembered by those who met him here last summer.

—Mr. F. M. Townsend has resigned as Superintendent of the Cleveland, Lorain & Wheeling. He he has been in the service of the company for 13 years as Station Agent, Purchasing Agent, Paymaster, and for the past four years as Superintendent. He now goes to Sonora, Mexico, to take charge of the Mexican interests of Mr. G. R. Perkins, who is President of the railroad.

—Mr. James Clayton, of the Clayton Air Compressor Works, New York, will sail on the Cunard steamer "Aurania" for Liverpool on Saturday. Mr. Clayton will spend a well earned vacation of about three months traveling through England and France, and while in the former country will for a time be the guest of his brother, Mr. Thomas G. Clayton, the Superintendent of the Midland Railway. Before his departure Mr. Clayton was presented with a handsome gold watch by his employés.

—Mr. John M. Watts, late Superintendent of the Toledo division of the Lake Shore & Michigan Southern, was given a banquet at Toledo this week by the trainmen, at which over 200 of the employés of the division were present. A handsome silver service was given to Mr. and Mrs. Watts, and a diamond solitaire to Mr. Watts with a handsomely engrossed testimonial. Mr. Watts was connected with the Lake Shore for 30 years, beginning as a telegraph operator.

—Mr. O. A. Haynes, one of the best known railroad officials in the Southwest, died last week in St. Louis. He was formerly Superintendent of Motive Power on the St. Louis, Iron Mountain & Southern for 15 years. He served his apprenticeship on the Rome, Watertown & Ogdensburg. He was an able and attentive officer, universally loved by his men, and also enjoyed the confidence of the officials above him. During the great strike of 1877 he was one of the few officers whose men did not go out on strike.

—Mr. W. W. Finley, who recently resigned the chairmanship of the Western Passenger Association, has been appointed General Traffic Manager of the Great Northern. Mr. Finley began railroading in 1873 as a stenographer on the New Orleans, Jackson & Great Northern. Since that time he has occupied the positions of Assistant General Freight Agent, General Freight Agent, and in June, 1889, was elected Chairman of the Trans-Missouri Freight and Passenger Association. In October, 1890, he resigned that position to become Chairman of the Western Passenger Association.

—The appointment of Mr. Samuel Rea as Assistant to the President of the Pennsylvania Railroad was announced this week by the Board of Directors, taking effect at once. Mr. Rea is recognized as an able railroad officer and engineer. He is a native of Hollidaysburg, Pa., and his railroad experience began in 1871, in Morrison's Cove, under Mr. James McCrea, now Vice-President of the Pennsylvania Lines West of Pittsburgh. He continued in the service of the Pennsylvania until 1890, when he resigned the office of Assistant to the Vice-President of the Pennsylvania to become Vice-President and Chief Engineer of the Maryland Construction Co., building the Baltimore Belt road. For the last year he has been engaged in business in Pittsburgh.

ELECTIONS AND APPOINTMENTS.

Burlington, Cedar Rapids & Northern.—The annual meeting of the stockholders of the company was held at Cedar Rapids, Ia., last week. J. C. Peasley, of Chicago; W. G. Purdy, of Chicago; J. W. Blithe, of Burlington, and W. H. Truesdale, of Minneapolis, were elected Directors for three years. The following officers were chosen: President, C. J. Ives; Superintendent and Vice-President; Robert Williams; Treasurer, H. H. Hollister; Secretary and Assistant Treasurer, S. S. Dorwart.

Chicago, Milwaukee & St. Paul.—H. E. Pierpont, formerly Commercial Agent at Kansas City, has been appointed Division Freight and Passenger Agent, with headquarters at Winona, Minn., succeeding J. T. Conley, promoted.

Dayton & Michigan.—At the annual meeting of the company at Dayton, O., May 17, the old board of directors was re-elected. This line is operated by the Cincinnati, Hamilton & Dayton under a 99-year lease.

East Tennessee, Virginia & Georgia.—J. D. Clark has been appointed Superintendent of the Mobile & Birmingham road, vice G. R. Talcott, resigned, to accept a position as civil engineer in Richmond, Va. Mr. Clark's headquarters will be at Mobile, Ala. He was formerly trainmaster of the Alabama division at Birmingham, Ala.

Flint & Pere Marquette.—The stockholders of the company held their annual meeting at Saginaw, Mich., May 18, 64,577 shares out of 96,402 being represented. The following Directors were elected: W. W. Crapo, Loum Snow, New Bedford, Mass.; J. W. Mackintosh, F. V. Parker, J. Lewis Stackpole, Boston, Mass.; Lewis Pierce, Portland, Me.; George Coppell, New York; H. C. Potter, H. C. Potter, Jr., Saginaw; W. H. Tousey, Bay City, and Henry B. Stone, of Chicago, who was chosen in place of Hon. Wm. L. Webber, who resigned in January.

Fort Worth & Trinity Valley.—The directors of the road organized at Fort Worth, Tex., this week are as follows: John W. Candler, Boston, Mass.; David S. Baker, Providence, R. I.; Stephen B. Brown, and James Craig, St. Joseph, Mo.; Martin Casey, Charles J. Larimer, Charles J. Swasey, Michael B. Riley, and Charles S. Frost, Fort Worth. The officers are: President, Stephen B. Brown; Vice President, Martin Casey; Secretary and Treasurer, Charles L. Frost; Assistant Treasurer, William L. Candler, Boston.

Great Northern—W. W. Finley has been appointed General Traffic Manager, with headquarters at St. Paul, Minn., vice P. P. Shelby transferred to the Pacific Coast. Mr. Finley will have jurisdiction over the St. Paul, Minneapolis & Manitoba; Duluth, Watertown & Pacific; Wilmar & Sioux Falls and Montana Central railroads. A circular issued May 23 announces that the jurisdiction of E. B. Wakeman, as General Superintendent of Transportation, has been extended over the lines of the Montana Central.

Kansas City, Fort Scott & Memphis.—W. A. Nettleton has been appointed Superintendent of Terminals route at Memphis, including the new Memphis bridge. He is a son of Gen. George H. Nettleton, President and General Manager of the system.

Louisville, New Orleans & Texas.—R. H. Talley, General Agent of the Passenger Department of the Newport News & Mississippi Valley and of this company at Memphis, will be succeeded on June 1 by Howard Jolley, formerly ticket agent at Louisville of the Ohio & Mississippi road and now ticket agent of the St. Louis Southwestern at Fort Worth, Tex.

Louisville Southern.—S. M. Felton, of Cincinnati, has been elected President in place of Theodore Harris, of Louisville, and M. F. Smith, Secretary, in place of William Cornwall.

Macon & Northern.—The following officers have been chosen: Hon. N. E. Harris, of Macon, Ga.; J. C. McMaster, of South Carolina, Superintendent, with headquarters in Macon; A. H. Hodgson, of Athens, Auditor and General Freight and Passenger Agent, with headquarters at Athens, and E. W. Burke, of Macon, Treasurer, with headquarters at Macon.

Mason City & Fort Dodge.—At the annual meeting of the stockholders last week at Fort Dodge, Ia., the following Directors were elected: J. J. Hill, D. C. Shepard, W. A. Stephen, G. P. Hickey, of St. Paul, and Hamilton Browne, of Fort Dodge, Ia.

Missouri, Kansas & Texas.—The newly elected board of directors have elected H. C. Rouse as President in place of H. C. Cross, resigned. Mr. Rouse will also be chairman of the board of directors. The other officers are: Vice-Presidents, J. Waldo, T. C. Purdy, William Dowd; Treasurer and Secretary, Charles G. Hedge; Assistant Secretary for Kansas, Lee Clark; for Missouri, J. C. Thompson, and for New York, J. B. Swain, Jr., and Devereux Toler; Local Treasurer at Parsons, Kan., R. W. McGuire.

Missouri, Kansas & Texas of Texas.—The annual meeting of the Texas company was held at Denison, Tex., May 19. The following were elected officers: President, H. C. Rouse, New York; Vice-Presidents, C. J. Waldo, St. Louis; R. C. Foster, Denison: Secretary, F. P. Merrill, Denison; Treasurer, N. S. Ernst, Denison; Assistant Secretary and Treasurer, C. G. Hedge, New York. All of the Directors of last year were re-elected except H. C. Cross, in whose place J. N. Simpson, of Dallas, was elected.

New York, Lake Erie & Western.—Frank Goodrich, formerly in the office of Deputy City Engineer Edward B. Guthrie, of Buffalo, and before that with the Buffalo & Geneva, has been made Assistant Engineer of the Erie, to take the place of Dennison Fairchild, who has become engineer for Contractor W. R. Haven on the new Depew shops of the New York Central near Buffalo.

Norfolk & Western Co.—P. F. McDonald has been appointed Supervisor of the Durham Division, with headquarters at Lynchburg, Va.

Northern Pacific.—J. W. Kendrick, in addition to his duties as Chief Engineer of the Northern Pacific, has assumed charge of all engineering and construction matters connected with the Chicago & Northern Pacific, Chicago & Calumet Terminal and Wisconsin Central lines, with the title of Chief Engineer of the respective companies. The separate offices now maintained for the above named companies will be consolidated, and will be located at the Grand Central Station, Chicago.

Omaha & St. Louis.—At the annual meeting of the company James H. Smith, W. H. M. Pusey, Charles G. Thompson, L. A. Sheldon, Walter Round, George Warren Smith and Henry W. Eaton were elected Directors.

Pittsburgh, Youngstown & Ashtabula.—The following directors were elected at the annual meeting: H. L. Morrison, T. E. Hoyt, of Ashtabula, O.; C. B. Wick, W. S. Bonnell, J. G. Butler, Jr., of Youngstown; W. Mullins, W. Thaw, Jr.; J. McCrea, J. Davidson, of Pittsburgh; G. B. Roberts, J. N. Hutchinson, of Philadelphia. The directors elected J. N. Hutchinson President; T. B. McKnight, Treasurer, and S. B. Liggett, Secretary.

Snow Fork & Hocking.—The incorporators are David Lee, of Zanesville, O., and S. P. Peabody, Frank W. Merrick, Vincent Ferguson and E. T. Affleck, of Columbus, O.

Sioux City & Northern.—J. C. Coombs has been appointed General Superintendent of the Sioux City & Northern and the Pacific Short Line roads. He succeeds F. C. Hills, who resigned a few days ago.

Texas, Louisiana & Eastern.—The present officers of the company are as follows: C. M. Putnam, of Kansas City, President; James A. Smyth, Secretary; N. B. Putnam, Consulting Engineer; W. C. Beach, of Conroe, Tex., Chief Engineer.

Wheeling Bridge & Terminal Co.—C. O. Brewster, of New York, has been chosen President of the Terminal Company, vice W. B. Thomas, of Boston, resigned, who was elected a few weeks ago. H. Umstead, of Hartford, Conn., was chosen Vice-President, to succeed J. Kennedy Tod, of New York, resigned. R. B. Ferris, of New York, formerly Secretary, has been appointed Secretary and Treasurer, vice Treasurer Hall, resigned.

Yakima & Sunnyside.—William H. Hall, of San Francisco; Edward N. Castilio, Paul Schultz, Peter P. Eaton, of Tacoma, and Walter N. Granger, of North Yakima, Wash., have chartered this company.

Zalisco Pacific.—The Directors of this company, chartered in Colorado last week, are: Charles W. Drake, Theodore H. Friend, Walter Hinchman, Charles Meller, Theodore F. H. Meyer, John Pratt and Spencer Trask, all of New York; Joseph A. Davidson, George B Moffatt, George F. Peabody and Samuel Scovil, of Brooklyn; F. Eugene Crassons, of Hackensack, N. J., and Charles Peabody, of Englewood, N. J.

RAILROAD CONSTRUCTION.
Incorporations, Surveys, Etc.

Adirondack & St. Lawrence.—The track laid on this road between Malone and Poland now aggregates about 106 miles, and the southern end of the line track is completed for 33 miles north of Poland, or 49 miles north of Herkimer, with the exception of a short distance near Prospect, where the bridge crosses the West Canada Creek is still unfinished. On the northern end of the line, track has been laid from Malone south to Wolf Pond, 17 miles. North of Malone to Valleyfield, Que., 23 miles, the line is leased to the Central Vermont, and is operated by that company. The balance of the completed track is on two other sections; between Rainbow Station and Saranac Lake, and from a point above Tupper Lake to Bog River. The work from the latter point to the Old Forge is the most difficult on the entire road. McDonald, Shea & Co., of Knoxville, who are the contractors for the grading, have over 2,000 men at work. The passenger department announces that regular passenger and freight train service will be inaugurated between Herkimer and Fulton Chain Station near Old Forge, 58 miles, on June 13. The connection will be made at Herkimer with trains leaving New York at 9:15 p. m. daily.

Altamont & Manchester.—The construction of the road has been commenced at Altamont, Ky., on the Louisville & Nashville. The route is to extend East, about 20 miles to Manchester, in Clay County. C. Crooke is President, and F. E. Sampson, Secretary.

Atchison, Topeka & Santa Fe.—President Manvel in a recent interview stated that it was the purpose of the company to lay about 40 miles of second track from Chicago.

Austin & Northwestern.—The construction work west of the Colorado River, on the Llano extension, was completed last week to the Little Llano River, about six miles from the terminus of the extension. If the contractors are not delayed further by trouble from high water, the prospect is that trains will be running to Llano by June 10.

Baltimore & Ohio.—The work on the Metropolitan branch, extending the second track from Knowles to Rockville, Md., is being pushed vigorously. It has been

discovered, however, that the grading between Rockville and Randolph has been made too narrow, and this difficulty will delay the completion of this section of the work about six weeks.

Bangor & Aroostook.—It is proposed to begin the grading on this line at Brownville, Me., on June 20, and at Houlton, on the northern division of the road, about the same date. It is said that 500 men will be at work on the grading during the summer. Messrs. Ross, Fitzpatrick & Harris, contractors, of Boston and Montreal, recently went over the line south of Presque Isle, and they have put in bids for that division. McDonald, Shea & Co., now of 47 Broadway, have, a late report says, undertaken to build the entire line.

Beaver Creek.—The grading has been commenced on this road near Davis, W. Va., but only a small force is employed, as the work is being done directly by the company, no contracts having been let. It is proposed to build a line from Davis, north to the mouth of the Stoney River, a distance of about 25 miles, connecting at its northern terminus with the West Virginia & Pittsburgh near Gorman, W. Va.

Beaver Creek Lumber Co.—This company is reported to be prepared to build 20 miles of railroad for lumbering and public uses in Tucker County, W. Va. W. M. Weller, of Cumberland, Md., will have charge of the engineering department.

Bristol, Elizabethtown & North Carolina.—The Unaka Construction Co. is arranging to resume the work on the line between Bristol, Tenn. and Elizabethtown, N. C., which has been suspended for nearly six months. The grading has been completed for 24 miles between these towns and the ties distributed. Rails for about five miles of the road have been received, and these will be laid as soon as the material for the bridge is received from the shops. A branch is to be built east to Mountain City, in Johnson County. It is proposed to continue the main line from Elizabethtown to Asheville, N. C. So far no work has been done south of the former town. John H. Caldwell, of Bristol, is General Manager, and George S. Bruce is the Superintendent and Chief Engineer.

Brunswick, Western & Southern.—About six miles of the line has been graded near Southport, N. C., since work was begun about a week ago. The work is being done by the company, about 200 men being employed, and no contracts will be let. The line has been located to Wilmington, 27 miles, and the right of way secured. H. H. Dougherty, of Newark, N. J., is General Manager, and Walter G. McRae, of Wilmington, N. C., is Chief Engineer.

Burlington, Cedar Rapids & Northern.—The contract for the extension of the Cedar Rapids, Iowa Falls & Northern, one of the leased lines of this company, from Forest City west 45 miles in the direction of Estherville, Ia., was let on May 14 to Kimball & McNamara, of Sioux City. The work is light, with no large bridges or important trestles. The extension is to be completed by Oct. 1. The terminus of the present contract is at a point in Emmet County near Estherville.

Burlington & Missouri River.—About a mile and one-half of track is being laid daily on the extension beyond Gillette toward Buffalo and Sheridan, Wy. It is expected that the rails will be laid to the crossing of the Powder River about 50 miles beyond Gillette, and trains run to that point early in the fall. The contractors are employing at present about 2,500 men on the grading and tracklaying.

Canadian Roads.—The Dominion Parliamant has passed bills amending the charter of the Quebec, Montmorency & Charlevoix road; to incorporate the Montreal & Lake Maskinonge Road and the Lachine & Hochelaga.

Charleston, Clendenin & Sutton.—Work on this line in Kanawha County, W. Va., is progressing rapidly and the first 10 miles of the roadway is graded and ready for the track. Tracklaying will begin soon.

Chesapeake & Ohio.—The second track between Alderson and Lowell, W. Va., 9½ miles, which was put under contract last December, is now in operation. The 8½ miles of second track between Low Moor and Covington, Va., which was begun at the same time, has not yet been completed. Fourteen miles additional of second track is now under contract as follows: From Caldwell, W. Va., to Rockland, 9 miles, and from Rush Run to Butcher's Branch, 11 miles. About 24 miles of extensions are now being built on various divisions. These are: Rush Run to Butoner's Branch, 11 miles; from Nuttall, W. Va., to Withrow's Mills, 5 miles; from Gauley to Twenty-Mile Creek, 8 miles. The contractors are C. D. Langhorne, Eggleston & Dennis, Montague & Tyler, of Richmond, Va.; J. C. Carpenter, Clifton Forge, Va.; W. A. Rinehart, Covington, Va., and G. G. Gooch, Staunton, Va.

Chicago & Alton.—A second track has been laid from Pontiac to Lexington, Ill., near Bloomington, a distance of 18 miles. It is not quite ready for operation, but probably will be about July 1. No other double track work will be undertaken this year.

Chicago, Burlington & Northern.—It is reported that engineers of this company are making surveys east of Prairie Du Chien, Wis., to a connection with the Kickapoo Valley & Northern at Wauzeka, its southern terminus. The new line will be 15 miles long, running east on the north side of the Wisconsin River.

Chicago, Ft. Madison & Des Moines.—The contracts for the extension from Libertyville west to Ottumwa, Ia., a distance of 20 miles, were awarded last week to Mallory, Cushing & O'Keefe, of Omaha, Neb.

Cleveland, Cincinnati, Chicago & St. Louis.—The company is said to have closed a contract with the Goshen Hydraulic Co. and a number of manufacturers at Goshen, Ind., for the construction of a belt line around that city, to be five or seven miles long.

Columbus, Lima & Milwaukee.—It is reported on good authority that the arrangement for the sale of the road has been finally closed, and that rails and material will be laid between Defiance and Lima, O., within the next three weeks.

Dakota, Wyoming & Missouri River.—It is promised that this road will be completed to a connection with the Burlington & Missouri River within six months. Rapid City voted $100,000 in bonds to aid in the construction, with the understanding that this much of the line should be finished this year.

Dutchess County.—The road was opened for business on May 21 between Poughkeepsie and Hopewell Junction, N. Y., having been formally transferred last week to the Philadelphia & Reading, which is to operate it. The road is 13 miles long, and connects the Poughkeepsie Bridge system with the New York & New England. The track was laid last year, but the masonry for the bridges could not be secured when needed, and was the principal reason for postponing the opening of the line to this time.

East Louisiana.—The branch from Abita Springs to Mandeville, La., on Lake Pontchartrain, was completed last week, and the new line will probably be opened in about a week, as soon as the ballasting is finished.

Exeter & Amesbury.—The proposition made by this company to the directors of the Concord & Montreal to have that company undertake the construction of the line, will be acted upon, it is promised, at the June meeting of the Concord & Montreal directors. The Exeter & Amesbury was organized about a year ago to build a long proposed branch line between East Epping and Exeter, N. H., eight miles. The local company raised money for the surveys and two lines were run. It was then proposed that the Concord & Montreal build the line or lease it, and its engineers went over the line, but definite action by the directors has been continually postponed.

Flint & Pere Marquette.—General Manager Baldwin states that the recent reports regarding the building of an extension of the Harrison branch are erroneous, as the company has no plans for such an extension, and does not contemplate any new construction work.

Geneva, Florala & Pensacola.—A survey has been commenced for the proposed line from Geneva, Ala., southwest to Florala on the Florida state line, a distance of 30 miles. The survey will probably be continued to Pensacola, Fla., a distance of about 80 miles from Geneva, called Cramer's Hollow.

Geneva & Van Ettenville.—The track of this branch of the Buffalo & Geneva is now practically completed, except a gap of 18 miles on the middle portion of the road in Schuyler and Seneca counties along the eastern bank of Seneca Lake, between Lodi, N. Y., and a point north of Odessa.

Grafton & Greenbrier.—This road, which was purchased last fall by the Baltimore & Ohio, has been changed from narrow to standard gauge, the work being completed last week, and the B. & O. train service put upon the road. The work is not yet entirely finished and may not be for some time, but the new service has been on for a week. There will be several new bridges to build, it is expected, to replace the present structures.

Great Northern.—Engineer Armstrong, of Kalispell, Mont., states that the tracklaying beyond that point is now proceeding at the rate of three miles a day west toward Spokane, Wash. The end of the track is now several miles west of Pend d'Oreille Bridge. Work is being pushed all along the line under construction. The track is to be completed into Spokane, Wash., on June 1. A switchback is now being built over the Cascade Mountains.

Houston Belt.—It is expected to complete the location of this belt line at Houston, Tex., and the officers state that they will let the contract within the next 30 days. Three preliminary surveys have been made around the city varying in distance from the corporation limits from 1,000 to 3,000 ft. Right of way has been secured along each of the lines. There will be one iron drawbridge and about 2,000 ft. of double track trestle. The company has secured funds to grade the entire road, ready for the ties and rails. The officers are now negotiating with the agents of New York and London capitalists for the sale of about $100,000 of the capital stock and $300,000 of the first mortgage bonds. R. H. Harrison, of Houston, is President.

Illinois Central.—The citizens of Grenada, Miss., have undertaken to secure for this company right of way for the branch from Parsons west to Grenada, Miss., 20 miles, which was recently surveyed.

Iowa Central.—The directors have agreed to build the proposed Ottumwa extension if the citizens raise a bonus of $40,000 and secure free right of way over the line recently surveyed by the company's engineers. The branch will be about 10 miles long from Hadrick on the present line, entering South Ottumwa along the Des Moines River.

Jalisco Pacific.—Articles of incorporation of this company were filed at Denver, Col., last week. The capital stock is $10,000,000. The company proposes to build a road from Manzilla, in the State of Colima, to Guadalajara, in the State of Jalisco. The same incorporators also filed articles for the Zacatecas & Potosi Railroad, to build from Zacatecas to San Luis Potosi, Mex., with a capital stock of $2,250,000.

Kingston, Napanee & Western.—The work is soon to commence on the extension north of Tweed, Ont., the present terminus, to Bridgewater and Madoc, Ont., a distance of about 10 miles. About four miles of new track only will have to be built, that is, between Tweed and Bridgewater. Beyond the latter town the company can use the grade built by the Grand Trunk some years ago, which was never put in operation.

Lachine & Hochelaga.—This company is applying to the Dominion Parliament for a charter to build a road from the town of Lachine, to the St. Lawrence River, to Point St. Charles and to other points in the city of Montreal. Extensions may be built from Lachine to Dorval and in the other direction to the northern end of the island of Montreal.

Lake Erie & Detroit River.—The contract has been let for grading 23 miles of the extension east of Leamington, Ont., the end of the contract being at Merlin, Ont. The extension has been surveyed for about 20 miles east of the latter town to Ridgetown, but no arrangement has been made for building this section. The contractors for grading on the section between Leamington and Merlin are Baird & Taylor, and Flood & Babcock, of Windsor, Ont., for the bridge and culvert work.

Lancaster, Cecil & Southern.—Work on the road is rapidly progressing between Childs and Providence Mills, Md., a distance of four miles. The balance of the route to Oxford, Pa., nine miles, will soon be let out to contract, and pushed to an early completion. This road will prove a valuable feeder to the Baltimore & Ohio, giving it a large traffic from the paper mills with which it will connect.

La Porte, Houston & Northern.—The La Porte syndicate has awarded the contract to J. F. Allen, of Lincoln, Neb., for grading the road from La Porte to Harrisburg, Tex., near Houston, a distance of about 15 miles. John H. Rice, of Fort Scott, Kan., is interested. The survey is being made by Major Woodbridge.

Macon, Dublin & Savannah.—General Manager Wright states that he will probably be ready to advertise for bids for building the Savannah extension by June 15. The route for the extension has now been definitely decided upon and he expects to have work in progress by July 1. The line from Dublin to Savannah will be 110 miles long.

Mason City Terminal.—The company filed articles of incorporation at Mason City, Ia., last week. John W. Long, of Chicago; Hamilton Browne, of Fort Dodge; C. Long, Thomas W. Carpenter and Frank A. Seymour, of St. Paul, are incorporators. The capital stock is $500,000. The company proposes to build a road to connect with the Chicago, St. Paul & Kansas City and another line northwest of Mason City.

Minneapolis, St. Paul & Sault Ste. Marie.—The contract for grading the first 25 miles of the proposed extension has been let to Linton & Conkey, of Minneapolis. This is along the Cheyenne River from Valley City, N. D.

Missouri, Kansas & Texas.—The City Council of Houston, Tex., has granted the company right of way along a number of streets in the city, and the bonus which the officers asked to be raised in Houston has been about subscribed. The new line is to begin at Boggy Tank, about 25 miles west of Houston.

Citizens of Austin, Tex., have undertaken to secure right of way for a branch into that city to leave the present line at Elgin or Copeland, about 25 miles east of Austin.

Navesink.—This road, the new line of the New Jersey Southern division of the Central of New Jersey, from Atlantic Highlands, connecting with the old Sandy Hook line at Highland Beach, N. J., will be opened May 29. The Sandy Hook boats from New York will run directly to Atlantic Highlands instead of to Sandy Hook as formerly. The new pier at Atlantic Highlands is 2,400 ft. in length, and has a width of 270 ft. for the first 270 ft., so that passengers can land on either of the three sides, or three boats can tie up at one time. From this point it narrows rapidly, until toward the shore it is only wide enough for a single track. On the outer end a one-story shed will contain the waiting rooms, ticket office, baggage room, etc. There will be 10 tracks with 16 ft. covered platforms between them. At the shore end there is a single "Y," one track leading to the left for the New Jersey Southern and Long Branch division trains and the other to the right to connect with the Atlantic Highlands branch to Matawan and the main line of the Long Branch division. The Union Switch & Signal Co. has erected a 28-lever tower about the centre of the long pier, operating tracks on the pier and approaches. In the construction of the pier about 7,000 piles and 300,000 ft. of yellow pine were used, all the timber being creosoted. Six-pile drivers, placing an average of 200 piles a day, were used on the work. In dredging to obtain sufficient depth at low water off the end of the pier a small ledge of rock was struck which had to be blasted away. The new road extends along the base of the Highlands about five miles to the Shrewsbury River opposite Highland Beach, and is built on a foundation of rough stone dumped along the shore. The roadbed is stone and slag ballasted. Three working trains and 450 laborers have been engaged on this work since last November. To cross the Shrewsbury at Highland Beach there is a drawbridge of 270 ft. span, giving clear openings of 100 ft. each, and 1,330 ft. of pile trestle. The work was done under the direction J. H. Thompson Engineer of Construction of the Central of New Jersey, assisted by W. S. Sneden and S. H. Kupp, who were in charge. The contractors were Cofrode & Saylor, of Philadelphia, and Burke Bros., of Scranton. F. A. Bowen was Superintendent for Cofrode & Saylor.

New Boston.—The directors of the Concord & Montreal were authorized to lease this road at the recent stockholders' meeting, and this action will probably result in work being commenced on the construction of the line at once. The line has been surveyed from Parker Station, near Manchester, south to New Boston, about five miles, and is now ready for the contractors. George A. Wason, of Nashua, N. H., is President.

New Roads.—The Board of Trade of Tallapoosa, Ga., is promoting a scheme to build a road from Tallapoosa north to Rome.

Norfolk & Western.—Rodgers & O'Brien, of Roanoke, have a contract, it is reported, to build the Cripple Creek branch from Ivanhoe to Speedwell, Va., and will shortly commence work.

The track-laying force on the Ohio River extension entered Logan County, W. Va., last week, and is progressing at the rate of half a mile a day toward Elkhorn. It is expected that in a few weeks the track will reach the tunnel, and that at that time all the track then completed will be turned over to the operating department and regular trains put on from Kenova to the eastern terminus of the tracks.

Ohio River.—The engineers have put a force of men to work on the new bridge over Twelve Fall River on the Kenova extension and will complete it before work is resumed on the Guyandotte bridge. Prospects are good now for the extension to be completed and trains running to Kenova by August 1.

Pennsylvania.—A new road leading around the hillside, at Fort Washington, on the Trenton Cut-off, has been commenced, and when completed it will do away with two dangerous grade crossings. The company is progressing rapidly with the northern end of the Chestnut Hill extension, north of Philadelphia, the gap between the two sections being nearly filled in. It is the intention of the company to have the road in operation in the fall.

Pennsylvania & Northwestern.—Nine miles of second track has recently been built from Glasgow to Irvona, Pa., which is the junction of several coal branches with the main line. A second track is also being built from Bellwood, the southern terminus of the road to Lloydsville, Pa., eight miles. Kellar & Crossan, of Philadelphia, are the contractors for this work.

Pittsburgh & Lake Erie.—Engineers of this company are reported to be surveying a line from Layton station west to a point on the Belle Vernon road near Elizabeth, which is operated by this company. The new line would extend along Washington Run to the Monongahela River and would be about 13 miles long, reaching a rich coaking coal district. J. W. Moore, of Greensburg, and Joseph McKee, of Fayette City, who are large owners of coal lands through which the road would extend, are promoting the project.

The company now has a second track from Pittsburgh to the Ohio River crossing, and only eight miles remains to finish to complete the double-tracking of the main line between Pittsburgh and Youngstown. Last week three miles of second track between Kaisota bridge and Aile-

quippa was opened for traffic, and that completed the double track to the river. The only remaining part of the road not double-tracked is the eight miles between Newport and Edenburg, and work on it is being pushed rapidly.

Portland & Rumford Falls.—The extension is making good progress, the tracklaying having reached Dixfield Saturday, leaving but five miles to complete it to Rumford Falls, Me. The extension begins at Gilbertville, and is 15 miles long. Mitchell & Spofford, of Bucksport, Me., are the contractors.

Potomac Valley.—This road handled its first freight on the new line from Cushwa's Station to Williamsport, Md., last week. The line is completed to Ash's, seven miles from Williamsport, and is being pushed rapidly forward.

Rapid City, Missouri River & St. Paul.—Last year 15 miles of grading was done, and 30 miles additional is now being constructed by Chamberlain & Skinner, of Rapid City, S. D. The line is to be built through the Sioux reservation to Ft. Pierre, where a tract of 53 acres for station and yards has been secured. The length of the road from Rapid City to Pierre will be 167 miles.

Ridgefield & New York.—The contract for building this road has recently been let to the Lehigh & Pittsburh Construction Co., which now owns a majority of the railroad's securities. The road is to extend from Port Chester, N. Y., where a connection will probably be made with the New York, New Haven & Hartford, northeast to Danbury, Conn., a distance of 33 miles. The project is an old one, and a line was graded some years ago for about two-thirds of the distance between Port Chester and Ridgefield, 23 miles, and about $260,000 was expended on this work. This old roadbed is now in fair condition, and can probably be easily repaired. The construction company proposes to begin work near Port Chester with a small force before June 15. The company's charter authorizes it to extend the line from Port Chester parallel to the tracks of the New York, New Haven & Hartford, but nearer Long Island Sound, to the Harlem River. No surveys have been made for this section. The distance by the new line from Danbury to New York will be 55 miles. By the present route via the Housatonic it is 65 miles. C. C. Higgins, of 48 Wall street, New York, is Secretary of the company, and Delos E. Culver, of 145 Broadway, New York, is Chief Engineer.

Rio Grande Southern.—Contracts were closed last week for the rails for a 30-mile extension of this road. It is not stated what line the material is for, but it is probably to be used on the line from Mancos, Col., above Durango, south to the San Juan River, and Northern New Mexico, which was surveyed during the spring. The rails are to be 57 lbs. to the yard and will be made by the Colorado Coal and Iron Co., of Pueblo.

Rockaway Valley.—The tracklaying on the Morristown extension is expected to be finished from Mendham northeast to Morristown, N. J., a distance of seven miles, by July 1.

St. Paul & White Bear.—The contract for grading this line was sublet to Million, Dale & Bumgardner, of St. Paul. Work of laying track was begun May 16, and the work was completed on the 25th.

Sandusky, Ashland & Southern.—The City Council of Norwalk, O., has ordered an election for June 20 on the proposition to vote a bonus of $30,000 to this company, which proposes to build a line from Sandusky south to Norwalk toward Columbus. The line is east of the route surveyed by the Sandusky & Columbus Short Line, and would parallel that line. It is not expected that the bonus will be carried, or that much further will be heard of the project.

Sandusky & Columbus Short Line.—Work is being pushed rapidly on the grading south of Bellevue, O., near Sandusky. Several miles has been graded and tracklaying will be commenced in a few days.

Snow Fork & Hocking.—The incorporation of this road in Ohio was noted last week. The company was recently organized at Columbus for the construction of a line from the present terminus of the Rock Run branch of the Newark, Somerset & Straitsville road, in Perry County, to a point on the Baltimore & Ohio Southwestern, near the town of Athens, in Athens County. It will pass through the counties of Perry, Hocking and Athens. It is a branch into the coal fields of Ohio, for the benefit of the Baltimore & Ohio and the Columbus & Hocking Coal & Iron Co. The right of way is now being secured and the line surveyed. Work will be commenced upon it as soon as practicable. The line will be about 15 miles in length, but the exact amount of road to be built has not yet been decided. David Lee, of Zanesville, is President, and S. P. Peabody, of Columbus, Secretary.

Spokane Terminal.—An effort is being made by the Chamber of Commerce of Spokane, Wash., to get the four roads entering the city, the Northern Pacific, Union Pacific, Great Northern and Spokane & Northern to unite in building a terminal road through the city. A plan has been proposed by E. J. Roberts, Chief Engineer for the Terminal Committee, and the route surveyed from the station of the Spokane & Northern to Bridge street. Several branches are proposed, the principal one being to the factories on the north side of the city. A conference was held between officers of the railroad last week, but nothing definite was settled.

Wekiva, Bronson & Northwestern.—The railroad to be built by the Suwannee River Phosphate Co., to its phosphate mines, is to be constructed under the charter of this company. The line will be about 35 miles long, beginning at Bronson, on the Florida Central & Peninsula, and will extend in a northwesterly direction to Judson, Trenton and Franklin. A branch will be built from Trenton west to the Suwannee River near Fort Fanning. The surveys are all made, and the building of the road will be commenced in June. The line will be very level with maximum curves of four degrees, and there will be one small trestle. The company will lay 40-lb. rails and is now in the market for the track material and equipment, and also phosphate mining machinery.

West Virginia & Pittsburgh.—A tour of inspection over this road has just been completed by ex-Senator Camden, President of the road, and a number of capitalists. The most important extension now building is the line to the Gauley River. This will ultimately connect with the Chesapeake & Ohio. It was reported that the track on the line had now reached the Elk River, and that the grading has been practically completed the entire length. The road is 40 miles long, and begins at Flatwoods, on the main line above Sutton, W. Va.

Wichita Valley.—President Morgan Jones writes that the proposed extension west of Seymour to Benjamin, Tex., has been abandoned for the present. Mr. Jones intended to build this extension this year, but has decided to postpone the work.

Yakima & South Coast.—Griggs & Heustis, of Tacoma, the contractors, are reported to have 1,200 men completing the construction of this extension of the Northern Pacific. Trains will probably be running from Chehalis to South Bend in September. Work has been begun on the bridge work on the Western Division. Over 1,000,000 ft. of lumber will be used in the bridging. Eleven pile bridges will be erected, and about six Howe truss bridges. The most important is across the south fork of the Willapa River at South Bend, the others being over the sloughs and small streams near the town.

Yakima & Sunnyside.—This company has been incorporated in Washington by officers of the Northern Pacific, Yakima & Kittitas Irrigation Co., of North Yakima, Wash., to build a road through the lands owned by that company. The road will be constructed from North Yakima to Prosser, through the country known as Sunnyside, through which runs the canal of that name. One of the incoporators says that work will begin as soon as the question of right of way is definitely settled.

Yankton, Norfolk & Southern.—Contracts for grading the line south of Yankton, S. D., were to have been let last week. A small force has been grading about a mile of the road near Warsaw, Neb., for several weeks past. It is reported that J. T. M. Pierce, of Yankton, the promoter of the line, has negotiated in England the bonds to complete the road to Norfolk, Neb.

Yazoo City & Silver Creek.—Governor Stone on May 20 issued his proclamation granting a charter to this railroad. The incorporators are W. L. Shelton, Charles Clarke, L. Lippman, of Yazoo City, Miss., and T. H. Bowles, of New Orleans. The road will extend from Yazoo City to the conjunction of the Sunflower and Yazoo rivers and pass through the following towns: Craigs, Silver City, Belzonio, Ittabena and Campbellsville. The line will open up some of the finest lands in the rich delta district.

GENERAL RAILROAD NEWS.

Chicago, St. Paul, Minneapolis & Omaha.—The City Council of Mankota, Minn., has passed an ordinance granting the company permission to remove its tracks from the centre of the city and relay them along the river front, and granting the right of way over streets and alleys. The Omaha road will come into the city over the tracks of the Chicago & Northwestern.

Columbia, Newberry & Laurens.—An agreement has been recently made with the Atlantic Coast Line by which this line between Columbia and Clinton, N. C., 65 miles, is to be operated by the former system. The nature of the agreement is not published, but it is not a lease. The road has been operated for the last year by the South Carolina. It connects with the Georgia, Carolina & Northern, a division of the Atlantic Coast Line, at Clinton.

Concord & Montreal.—The stockholders at a special meeting last week voted to increase the stock $1,200,000 to make the capital stock $6,000,000, and the directors were authorized to issue the new stock at their discretion. Stockholders of all classes will have the right to subscribe for the new stock at par. It was also voted to authorize the lease of the New Boston road, which is to extend from a point near Manchester to New Boston, N. H., five miles. The increase of the capital stock was opposed by Frank Jones, and J. N. Sanborn, who are directors of the Boston & Maine, and they have since secured a temporary injunction to restrain the issue of the new stock, which will be argued June 13.

Green Cove Springs & Melrose.—The United States Court has ordered the sale of this road, a short Florida line, at Jacksonville, on June 6, to satisfy the mortgage claims of the Guaranty Trust & Safe Deposit Co. The road is about 35 miles in length, and extends from Green Cove Springs through Clay County to Melrose, in Alachua County, Fla.

Gulf & Ship Island.—On a petition filed by W. G. Evans, Jr., and J. R. Davis, of Biloxi, Miss., and Fewell & Bramer, of Meridian, Miss., attorneys for Harrison County, this road has been placed in charge of T. J. H. Stewart as Receiver.

Macon & Atlantic.—The Receiver, W. H. Sparks, of Macon, Ga., has applied to the Georgia Supreme Court for an order for a new sale of the road, to be made to the highest bidder, and it is believed that the order will be granted.

Macon & Northern.—In compliance with an agreement between the President of the Richmond & Danville and the Chairman of the Board of Receivers of the Central Railroad & Banking Co., of Georgia, this road will be operated by a Lessee Board representing both companies, and consisting of Messrs. N. E. Harris and J. F. Hanson, of Macon, Ga., and J. H. Rucker and A. H. Hodgson, of Athens, Ga., with Mr. N. E. Harris as President.

Northern Pacific.—The usual quarterly dividend, or one per cent. on the preferred stock, was passed by the Directors last week. The following statement was submitted: The surplus earnings amounted on Feb. 28, 1892, to $893,723; deficit for March, $3,732; surplus March 31, $989,990. From this surplus two dividends of one per cent. each have been declared and paid: On Oct. 15, $366,081; Jan. 15, 1892, $365,781; leaving applicable to the dividend for the present quarter, $258,128, or say $107,000 less than one per cent. on the preferred stock outstanding.

Oregon Pacific.—At a meeting in New York last week, at which about $9,000,000 of the bonds were represented, the bondholders formally assented to United States Judge Deady's decision which provides that Zephin Job, who recently bid the property in on a foreclosure sale, turn it over to a new company formed under the plan of the reorganization committee. Permission was given Mr. Job to hypothecate securities owned by the present Oregon Pacific, to complete the purchase of the property.

Pacific Mail Steamship Co.—The stockholders at the annual meeting last week approved the action of the directors in creating a $5,000,000 mortgage for the purpose of reconstructing the fleet in the Pacific Ocean, the China line. The annual report showed total earnings for the year ended April 30 of $4,409,263, expenses of $3,688,055 and net earnings of $721,208. Assets of $775,871, in addition to which there is due from the Central American and Mexican Governments $69,072 under contracts for carrying the mails. The liabilities were $637,739. President George J. Gould says: The gross earnings have increased during the year, but the net earnings have slightly fallen off, owing to the fact that we have been obliged to spend a large amount of money to put the fleet in condition to meet the increased requirements of the postal law of March 3, 1891, for carrying the United States mails. The company has also during the year entirely rebuilt two of its vessels, besides constructing two new ones, viz.: the "Columbia" and the "Peru."

Rochester, Hornellsville & Lackawanna.—This road will be sold on foreclosure at Angelica, N. Y., on May 31. It is 21 miles long, extending from Hornellsville to Wayland.

St. Louis Southwestern.—From a circular recently issued by President Fordyce, it appears that the earnings for the first eight months of the present fiscal year, July 1, 1891, to Feb. 29, 1892, have been: Gross earnings, $3,406,385; operating expenses, including $112,444 betterments, $2,626,783; surplus earnings (eight months), $770,601; fixed charges, taxes, $72,659, and eight months' interest, $533,333, a total of $605,992, leaving net earnings for the eight months of $173,609.

TRAFFIC.

Chicago Traffic Matters.

CHICAGO, May 25, 1892.

The "Soo" line has again made a reduction in the wool rates from St. Paul, the last cut being five cents per 100 lbs., making a rate of 75 cents to Boston. The Western Freight Association lines will meet the reduction on May 28, via Chicago and the Grand Trunk and Michigan Central lines.

The percentages of the business carried by the Chicago-St. Paul lines in the passenger agreement for the month of April are as follows: Chicago, M. & St. Paul, 30.6 per cent.; Chicago & Northwestern, 17 per cent.; Albert Lea, 15.6 per cent.; Wis. Central, 15.4 per cent.; C., St. P. & K. C., 14.2 per cent.; Chi., Buri. & Northern, 7.2 per cent.

The Rock Island and connections, composing the "Albert Lea" route, have given notice of withdrawal from the agreement on account of inability to comply with a recent order of the Board calling for the diversion of a large amount of Raymond & Whitcomb excursion traffic which the roads say they cannot divert, owing to the decided objections of the excursion managers. The other lines parties to the agreement are disposed to continue the arrangement notwithstanding the withdrawal of the Albert Lea, but as yet it is not decided what action will be taken.

An informal conference of the General Managers was held on Monday, and a canvass made in regard to the election of a chairman to succeed Chairman Finley in the Western Passenger Association. The meeting adjourned until next week without taking formal action. Indications are that the chairmanship will be tendered J. N. Faithorn, at present Chairman of the South Western Railway & Steamship Association.

The Freight Committee of the Central Traffic Association has voted to hold meetings bi-monthly after July. The Western Freight Association adopted this plan some months ago, and it has proved successful.

The Federal Grand Jury, on May 20, returned indictments against 13 ticket brokers for violation of the state law which makes it unlawful for any person not duly authorized by a railroad to sell its tickets. The parties indicted are: George M. McKenzie, George W. Frey, Edgar J. Hunter, J. McSchiely, R. H. Yunger, George A. Fellows, George Frank, H. A. Houston, Edward Lint, James A. Webb, Edward A. Mulford, C. H. Mitchell and C. F. Stout. The names of the witnesses given are: George J. Charlton, Chicago & Alton; John J. Byrne, Atchison, Topeka & Santa Fe; C. A. Kniskern, Illinois Central; F. A. Palmer, Wabash; S. F. Boyd, Chicago, Rock Island & Pacific (all of these are Assistant General Passenger Agents); James Barker, General Passenger Agent, "Monon"; Adolph Fraub, J. E. R. Hawley, Henry Farline and Wm. J. Calhoun. The indicted scalpers gave $500 bonds each. The law provides a penalty of a maximum fine of $500 or imprisonment for not exceeding one year, or both. The scalpers charge the whole trouble to the Burlington and St. Paul roads, and say it is in retaliation for their boycotting the tickets of those roads.

Traffic Notes.

The Western New York Car Service Association handled 36,901 cars in April, the average detention being 1.79 days. Nearly 96 per cent. of the cars were released within the free time limit.

The Philadelphia & Reading has reduced the rates on lumber from Western Pennsylvania to points on the Atlantic seaboard about 20 per cent. This reduction is similar to that made by the Erie, heretofore announced.

The schedules of the through trains between New York and Chattanooga over the Pennsylvania and the Norfolk & Western have been rearranged and shortened so that the time, through, is now four hours less than heretofore.

During the convention at Minneapolis, for those organizations unable to secure hotel accommodations, the railroads entering St. Paul will store the chartered trains near the Convention Hall and will provide the necessary sanitary connections.

The Union Pacific, after a conference with Railroad Commissioner Hamill, of Colorado, has reduced the rate on ore from Silver Plume to Denver from $3.25 a ton to $3, with proportionate reductions from certain other points. The Railroad Commissioner had recommended reductions nearly twice as large, and the result is a compromise. The report of the negotiations does not bear out the statements, heretofore made by Denver papers, to the effect that the railroads showed scant respect for the railroad commissioner.

The Trunk Lines Executive Committee, together with the managers of the lake lines, met in New York on Tuesday of this week, and voted to restore sixth class Eastbound freight rates to the basis of 25 cents per 100 lbs., Chicago to New York, on June 13, with the exception of grain; and to raise the grain rate on the same date from 20 to 22½ cents. It will be remembered that it has thus far been impossible to make these advances in rates, on account of the opposition of the lines leading eastward from St. Louis. It does not appear that the approval, either of those lines or of the Chicago committee, has yet been secured for the action now taken.

Eastbound Freight Shipments.

Eastbound shipments of freight from Chicago by all the railroads last week amounted to 51,336 tons, against 50,619 tons for the preceding week, an increase of 717 tons, and against 55,508 tons for the corresponding week last year, a decrease of 4,172 tons.

GEO. WESTINGHOUSE, JR., President. T. W. WELSH, Supt. JOHN CALDWELL, Treasurer. W. W. CARD, Secretary. H. H. WESTINGHOUSE, General Manager.

THE WESTINGHOUSE AIR BRAKE COMPANY

PITTSBURGH, PA., U. S. A.,

MANUFACTURERS OF THE

WESTINGHOUSE AUTOMATIC BRAKE

The WESTINGHOUSE AUTOMATIC BRAKE is now in use on 24,000 engines and 325,000 cars. This includes (with plain brakes) 252,000 freight cars, which is about 23 PER CENT. of the Entire Freight Car Equipment of this country, and about 80 per cent. of these are engaged in interstate traffic, affording the opportunity of controlling the speed of trains by their use on railways over which they may pass. Orders have been received for 173,000 of the Improved Quick-Action Brakes since December, 1887.

The best results are obtained in freight train braking from having all the cars in a train fitted with power brakes, but several years' experience has proven conclusively that brakes can be successfully and profitably used on freight trains where but a portion of the cars are so equipped. Below is a graphical illustration of the progress made in the application of the Automatic Brake to freight cars since its inception.

Year.	No. per year.	Grand total.
1881	105	105
1882	1,085	1,190
1883	4,966	6,156
1884	15,051	21,207
1885	10,410	31,617
1886	8,946	40,563
1887	9,281	49,844
1888	27,696	77,540
1889	26,065	103,605
1890	50,502	154,107
1891	39,061	193,168

193,168 freight cars fitted with the Westinghouse Automatic Brake, which is nearly 20 per cent. of the Entire Freight Car Equipment of this country.

E. L. ADREON, Manager. JOHN B. GRAY, Agent. C. C. HIGHAM, General Supt.

THE

AMERICAN BRAKE COMPANY.

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THE WESTINGHOUSE AIR BRAKE CO., Lessee,

MANUFACTURERS OF

CHICAGO OFFICE, GRAND PACIFIC HOTEL.

LOCOMOTIVE BRAKES.

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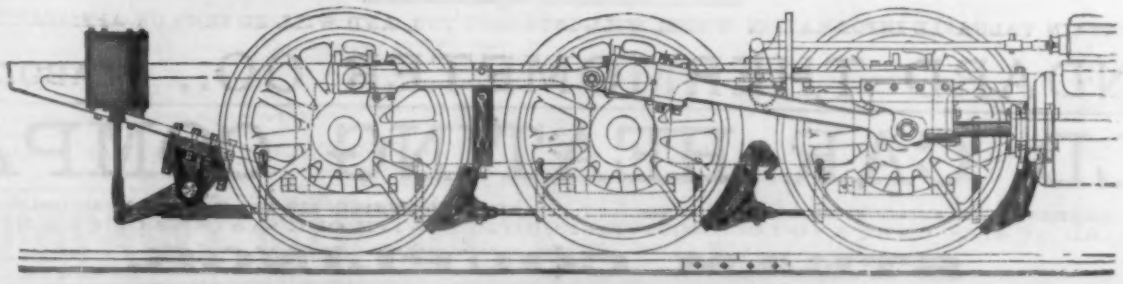
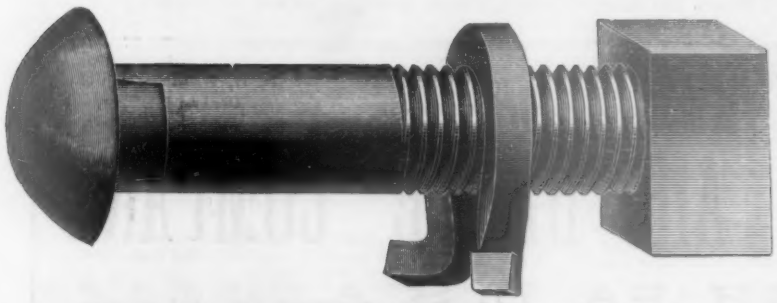


Standard Outside Equalized Pressure Brake, for two or more pairs of Drivers, furnished to operate with either STEAM, AIR or VACUUM.

THE "STANDARD" NUT LOCK



Manufactured under D. O. Ward's Patents by the

STANDARD NUT LOCK CO.,

NOS. 236-248 BANK ST., NEWARK, N. J.

SAMPLES FREE.

This nut lock is presented on its merits as the best and cheapest device for securing track joints.

It is a torsional loop made of good quality of tempered spring steel, having horizontally inclined foot pieces, which are curved inward, thereby greatly increasing the spring resistance and acting simultaneously: rests upon the base of angle bar, or underlying rail base in case of fish plate, preventing the loop portion from rotating and hammering down *thread* of *bolt*.

The nut lock for ¾ bolt made of ¼ in. square steel, standard pattern, yields a tension of 4,300 lbs. on the bolt, which is sufficient to reduce the wear of the bearing surfaces of the angle bars on the rails, imparting, as it does, a uniform bearing the entire length of the bar.

The "Standard" Nut Lock has sufficient elasticity to maintain a tight joint, which cannot be truthfully said of many light-weight single coil washers.

The "Standard" Nut Lock is, in its superficial form, similar to an annular coil twisted out of plain, *i. e.*, the curved shoulders or ends of the loop proper are spread in the usual manner of spring coils, at which bearing points the locking friction is equal to that of the best single coil washer, and added to this it is terminated in *inwardly curved* extensions, which must apparently furnish additional short leverage spring force of a torsional character.

Distinctive Merits of the "Standard" Nut Lock, Condensed:

Fixedness of position—cannot rotate and hammer down threads of bolt.

Cannot get one end into elongated slot of angle-bar.

Unlike any permanently placed, double washer, the Standard *is* interchangeable regardless of distance between bolts.

Cannot be put on wrong side out, as the outward projection of the foot pieces would prevent the nut being turned up.

Has more spring power directly under the nut than any two ordinary coil nut locks.

Being fixed in position it offers double the locking friction of nut locks, which when in their *dead* "set" condition turn back with nut by the vibrative effect of passing train.

The "Standard" Nut Lock embodies the old principle of spring power improved by overcoming the objection to the double washer or nut lock, and covering the weak points of the single coil washer.

Excelsior Automatic Nut-Lock and Fish Plate Spring

These Nut Locks have been adopted by the New England Road-Masters, in Conventions held at Hartford, Conn., Oct. 19 and 20, 1887, and Boston, Mass., Aug. 15 and 16, 1888, as the best Nut Locks known.

Sample lots furnished for trial, free of expense, by forwarding the distance between centres of fish-plate bolts. Correspondence and orders solicited.

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Patentees and Sole Mfrs., SCHUYLKILL FALLS, Philadelphia, Pa.

Simple. Easily Applied. Very Effective.

THE NATIONAL LOCK WASHER

THE ONLY POSITIVE NUT LOCK IN COMBINATION WITH ELASTICITY.

Sixty Millions in Use in Railroad Track

For Use on All Kinds and Classes of Work.

THE NATIONAL LOCK WASHER CO, Newark, N. J.

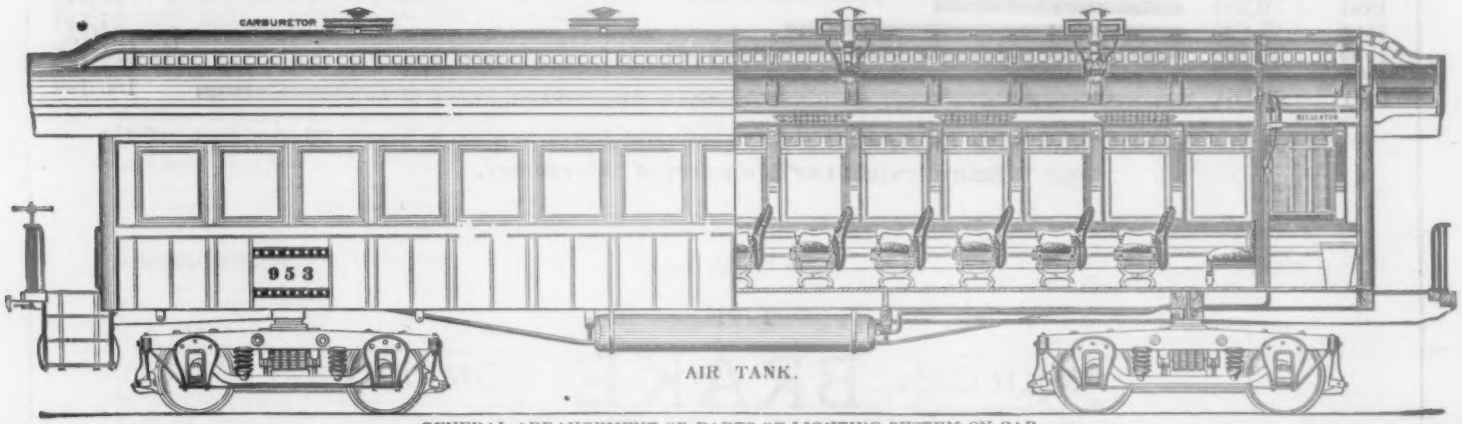
Made for all sizes of bolts.

A trial is requested.

Samples free of expense.

THE FROST DRY CARBURETOR SYSTEM OF CAR LIGHTING.

The Greatest Light of the Age. **Extensively Used by the Pennsylvania Railroad and the Pullman Palace Car Company.**



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It cannot fail to attract the attention of practical railroad managers on account of its absolute safety, durability, simplicity, efficiency and its great economy. Each amp gives 100 candle-power illumination. One hundred hours' continuous service from one charging of the carburetor.

THE RAILROAD LIGHTING & MFG. COMPANY. **Office, 700 and 701 Girard Building, Philadelphia, Pa., U. S. A.**

WE HAVE JUST ISSUED FOUR NEW CATALOGUES:

No. 26. Metallic Thermometers for Mechanical Uses.
No. 27. Metallic Thermometers for General Use.
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THEY CONTAIN VALUABLE INFORMATION WHICH WILL INTEREST YOU, AND WILL BE SENT ON APPLICATION TO THE

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UPWARD OF 4,000 CARS AND LOCOMOTIVES EQUIPPED WITH OUR SYSTEMS OF CAR HEATING.

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" UNIVERSAL, " " to couple with SEWEL.
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BY HOT WATER CIRCULATION AND DIRECT STEAM WITH REGULATING DEVICES.
RELIABLE AND UNIFORM HEAT. ∴ ∴ ∴ ∴
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GIBBS' AUTOMATIC COUPLER OF WESTINGHOUSE TYPE, ABSOLUTELY STEAM TIGHT.

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IN USE ON OVER 40,000 CARS IN EUROPE AND AMERICA.
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THE MARTIN ANTI-FIRE CAR HEATER

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Boston & Albany Railroad,
New York Central & Hudson River
Lake Shore & Michigan Southern,
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Cleve., Col., Cin. & Ind. "Bee Line,
Kings County Elevated,
Dunkirk, Allegheny Valley & Pittsburgh.
New York, Susquehanna & Western,
Cleveland & Canton,
West Shore,
Fall Brook Coal Co.,
Beech Creek Railroad.
Detroit, Lansing & Northern,
North. Cent. Div. of Pennsylvania System,
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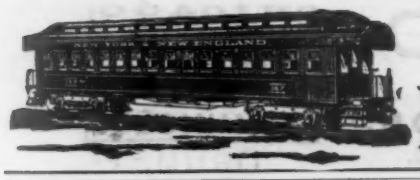
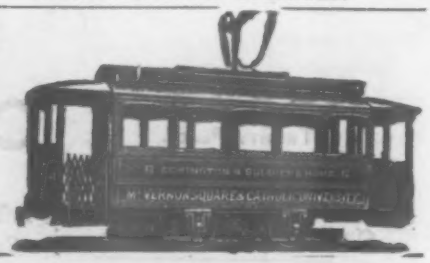

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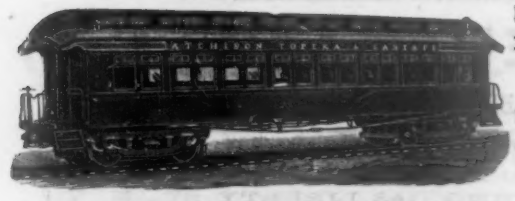
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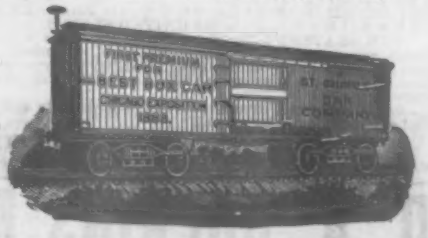
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THE SURVIVAL OF THE FITTEST."

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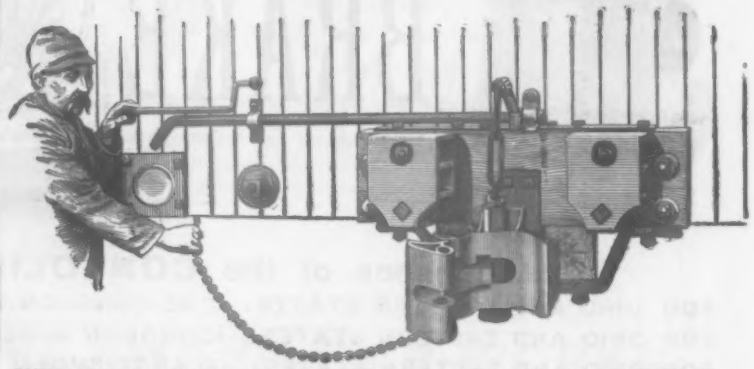

With Chain Attachment for Opening the Knuckle WHEN REQUIRED.

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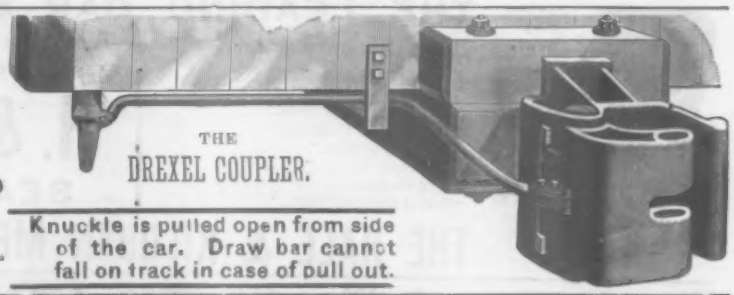

THE DREXEL COUPLER.

Knuckle is pulled open from side of the car. Draw bar cannot fall on track in case of pull out.

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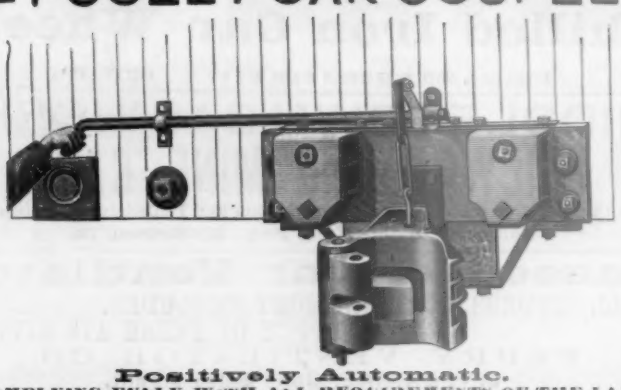

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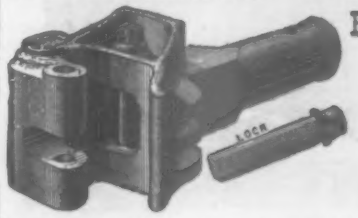

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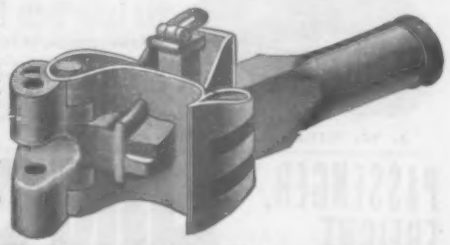

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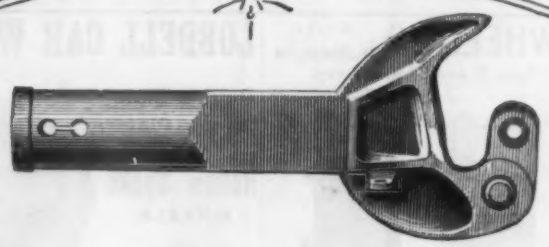

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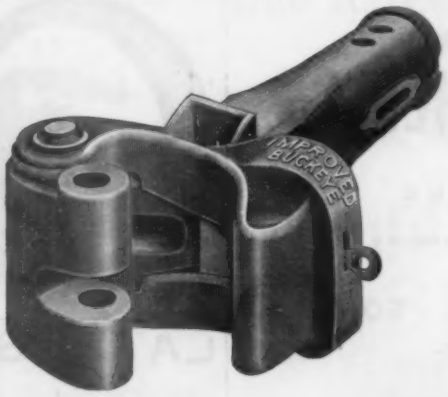

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Master Car Builders' Standard in every particular. Combines the greatest obtainable strength and simplicity. Only Three Parts. Positive acting gravity lock and positive mechanical opening of knuckle. Absolute Central draft. Same movement that raises the lock throws open the knuckle.

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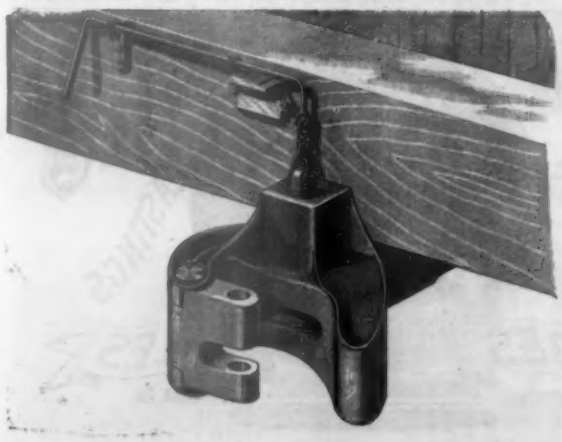

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WEIGHT 180 POUNDS.

MEETS ALL THE REQUIREMENTS OF THE M. C. B. LINES AND TESTS.

LOCKING DEVICE SIMPLE, DURABLE AND EFFECTIVE.

It Has but Four Parts and Cannot Be Opened by Accident.

KNUCKLE OPENS AUTOMATICALLY.

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CAPACITY, 400 WHEELS PER DAY.

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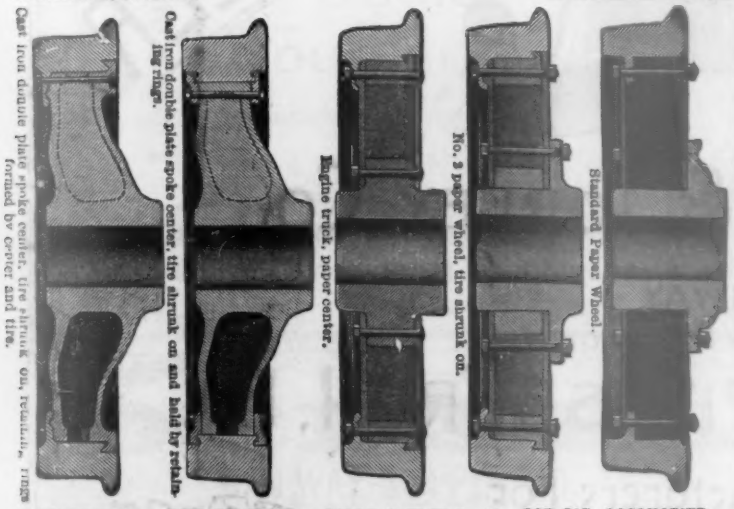
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STEEL-TIRED WHEELS FOR CAR, LOCOMOTIVE AND TENDER TRUCKS

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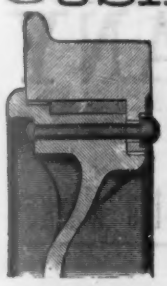

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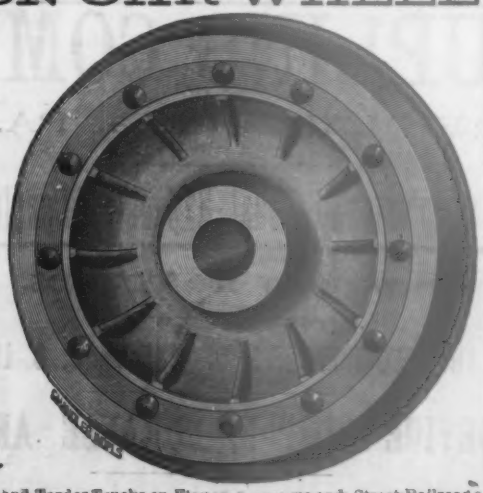

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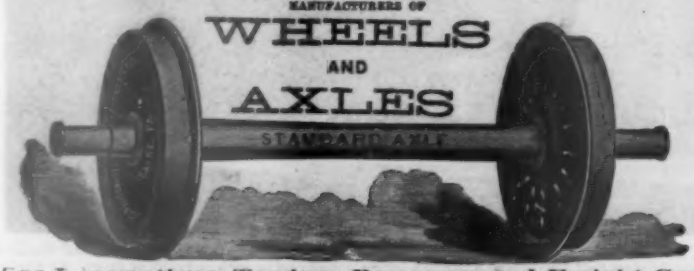

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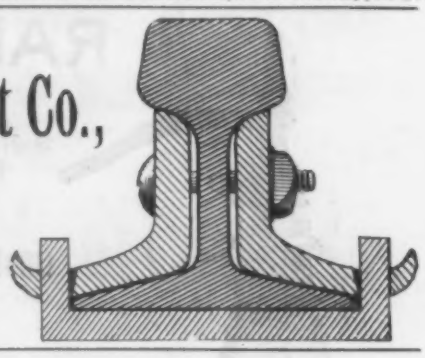

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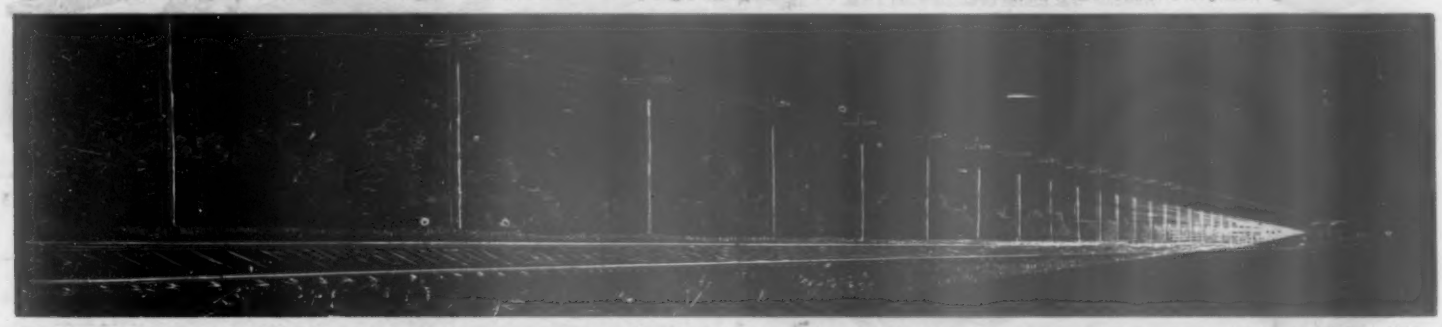

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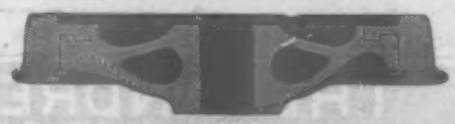

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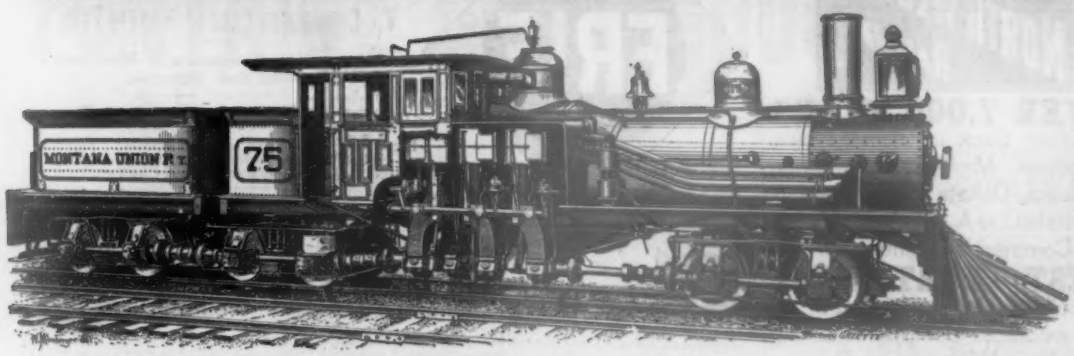

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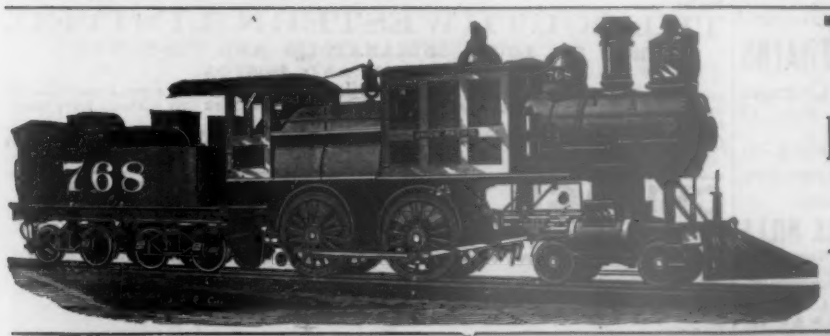

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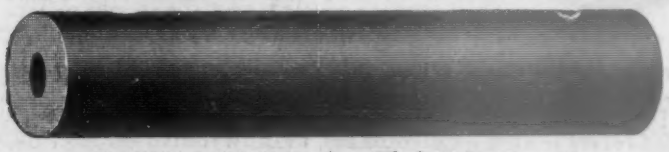

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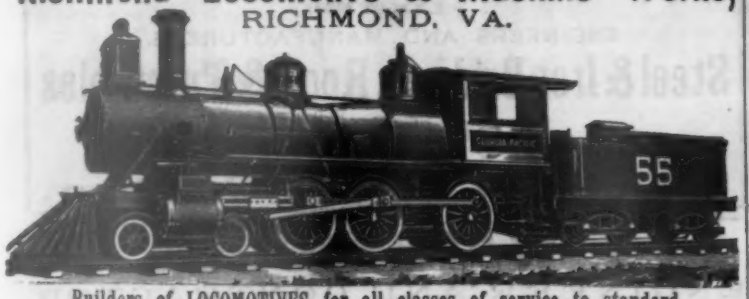

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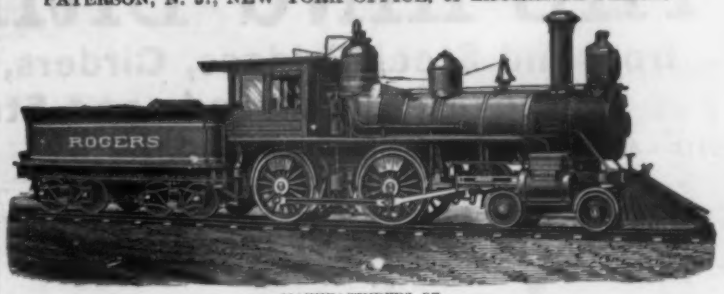

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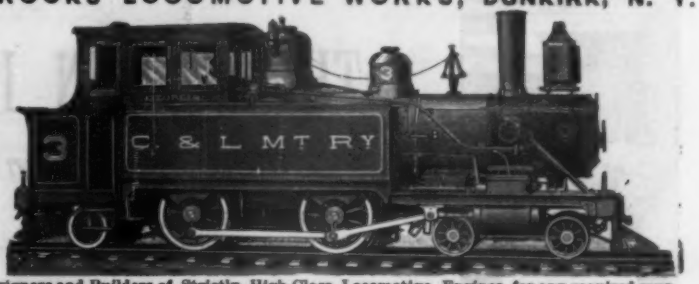

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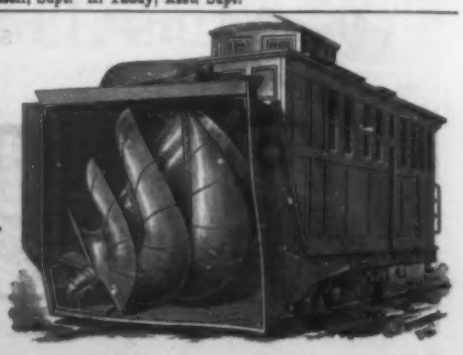

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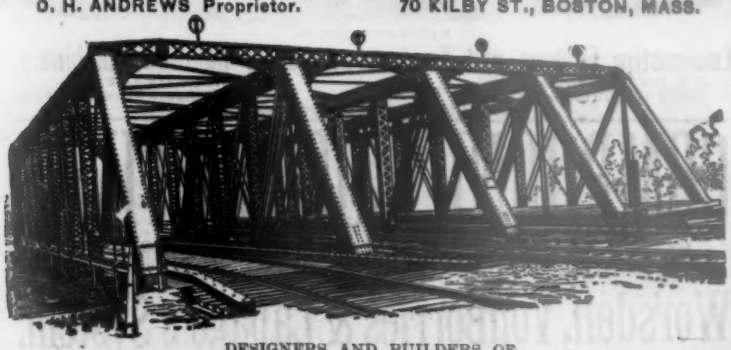

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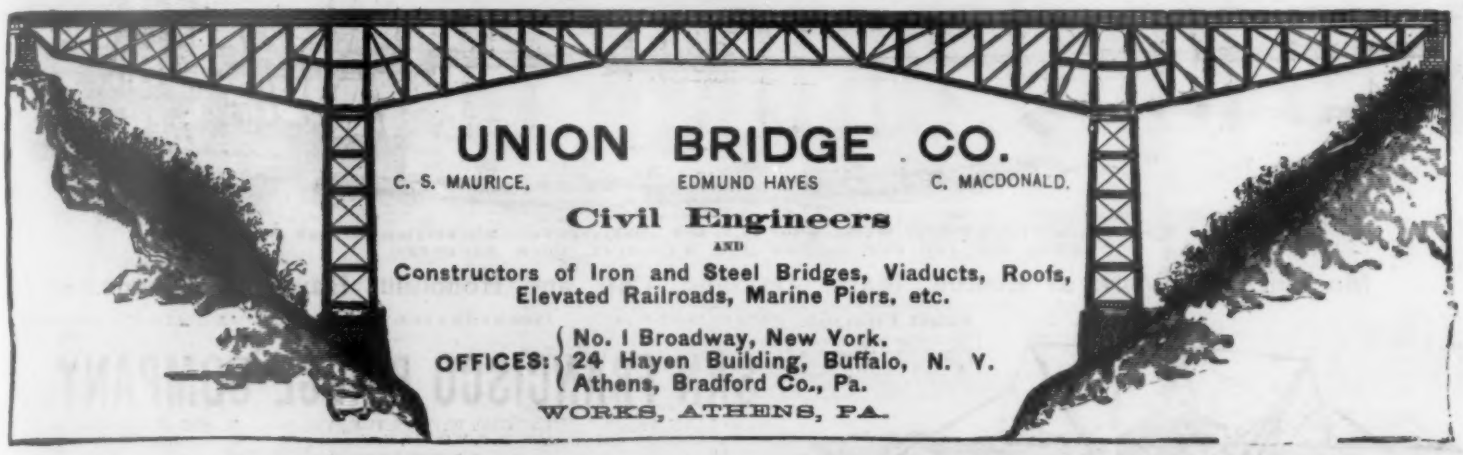

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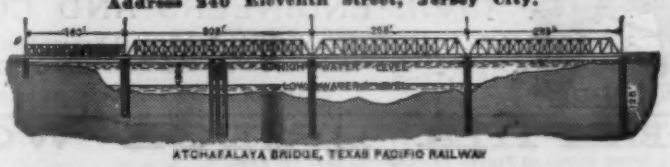

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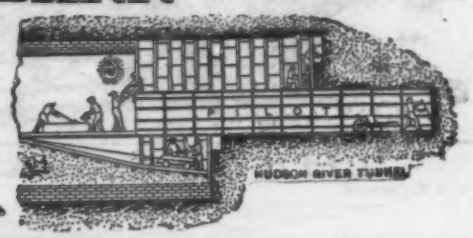

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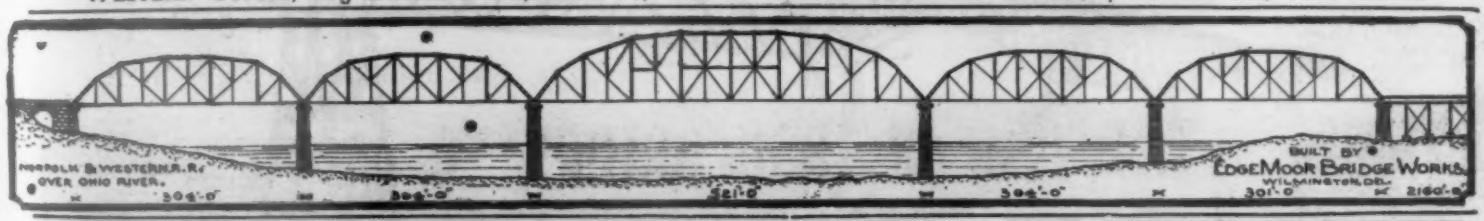

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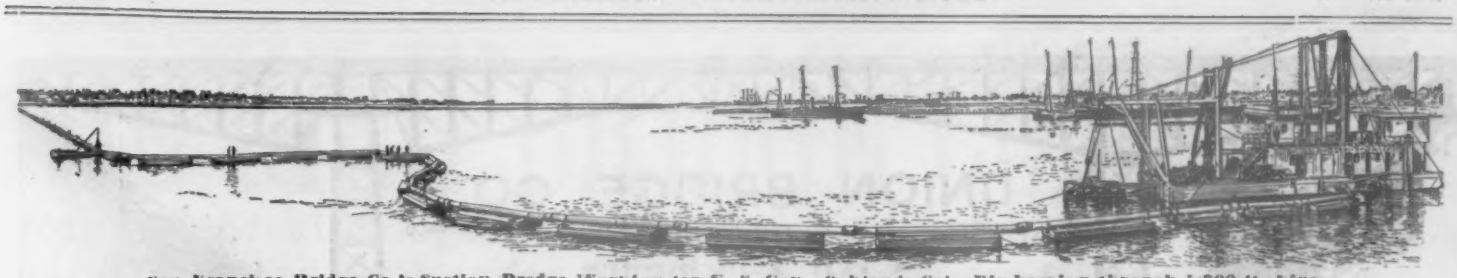

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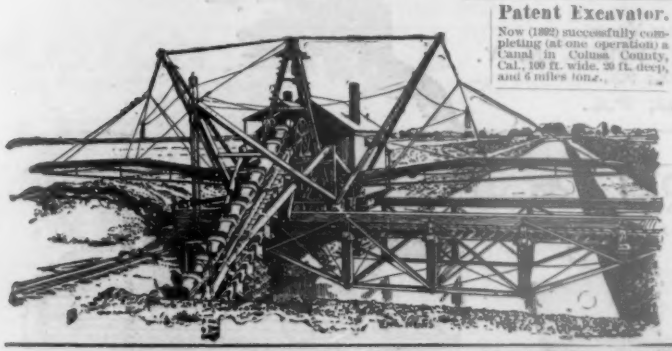

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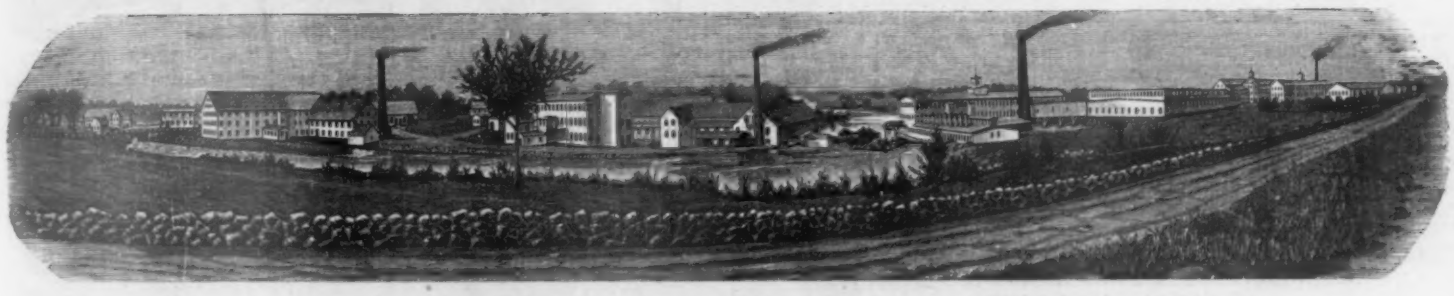

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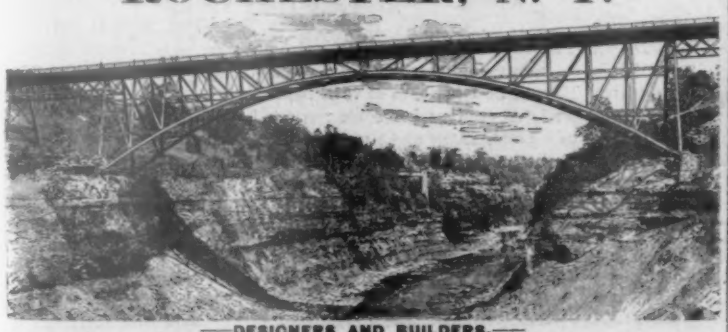

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THE TANITE CO.,
STROUDSBURG, PA.,
AND
161 WASHINGTON STREET, NEW YORK.
For many years the Tanite Co. has been known by name to New Yorkers as a foreign concern; as a manufacturing establishment way off somewhere in Pennsylvania, whose business was done through agencies and commission houses, and which, at long intervals, sent a personal representative on some special mission to the city.
The Tanite Co. has now withdrawn its New York agency, and has taken a long lease of the ground floor and basement of the new building conveniently situated between Liberty and Cortlandt streets. Here it will carry a complete line of
Emery Grinding Machines, Tanite Emery Wheels
Tanite Mills Emery, Solid Emery Oil Stones
and Triple-Coated Emery Knife Sharpeners.
Our New York store will be under the management of Mr. FRANK W. GILBERT.

DELAWARE, LACKAWANNA & WESTERN R. R. CO.,
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SIRS: We have been using your padding for coach seats and backs during the past five years. Have it now in about 45 to 50 coaches.
Consider it equally as good, and in some respects better than curled hair, just as durable, gives us a better shape and a more comfortable seat than curled hair, with a saving of about $30 to each car. Yours, etc
(Signed) J. W. BAKER, M. C. B.

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